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THE

ENGLISH MECHANIC:

A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

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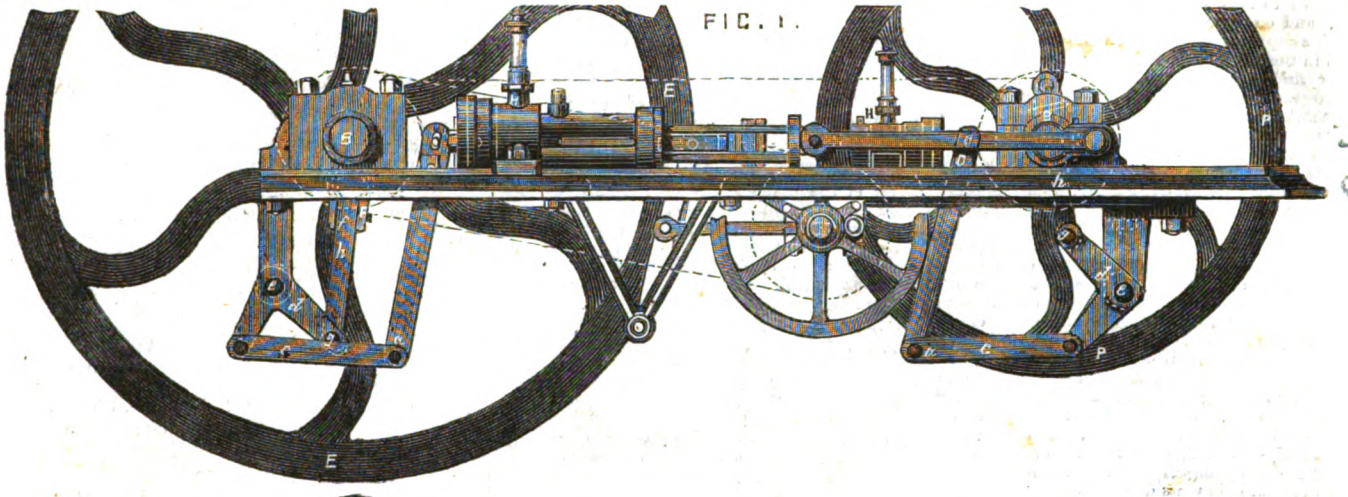

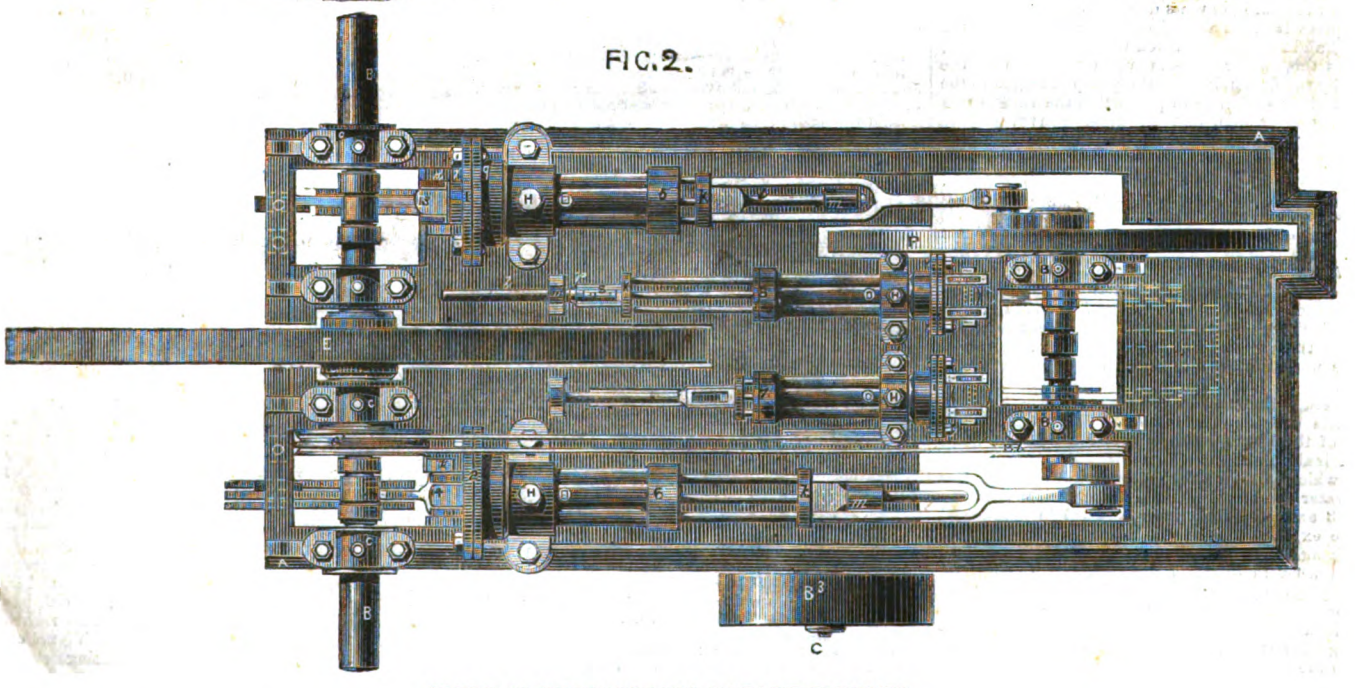

SLEIGH'S HYDROSTATIC ROTARY ENGINES.

HYDROSTATIC ROTARY ENGINES.

Letters patent have been granted to Mr. B. W. A. Sleigh, of 7, Alfred-place, Bedford-square, for improvements in the means of obtaining continuous rotary motion by means of a hydrostatic rotatory motive power engine for the propulsion of machinery.

The engine is placed upon a bed plate of metal, A, A, A, A, resting upon, if necessary, upright standards or bearers, between which revolve and work the parts of the engine beneath the bed plate. In the first place there are bolted down upon the foundation plate in a horizontal position, four ram cylinders, 1, 2, 3, 4, at the end of which are attached their respective series of pump plunger cylinders, 5, 6, 7, 8. Nos. 1 and 2 ram and pump plunger cylinders are placed with a space between, parallel to each other, as are also Nos. 3 and 4, only to the rear of the former. In each cylinder is a metal ram, 9, 10, 11, 12, and each cylinder is for a space within its mouth grooved out in a recess so as to form a stuffing box, through which the rams, 9, 10, 11, 12 pass outwards in giving their strokes, and then retire inwards after delivering the same. One set of ram cylinders, 1 and 2, with their rams, 9 and 10, face a main crank shaft, B, B, revolving through four plummer boxes or be arings, *c*, *c*, *c*, *c*, cast on the bed plate, with caps and trusses of metal; and the said shaft drives the wheels keyed thereon. Attached to rams 1 to 4 are screwed metal lugs, 13 to 16, through the centres of which are drilled holes in which pins, 17, traverse, fastening the forked levers, D, *d*, D, *d*, which stand vertically above and below surface of bed plate, to which they are attached by suitable lugs or pins at 17. The vertical levers D, D, D, D, in projecting below the bed plate, are at their fulcrums, *a*, *a*, attached to carriages or brackets hanging beneath, and bolted under surface of bedplate. Connecting rods, *c*, *c*, are pinned or jointed from *a*, *a*, to bell-cramp shaped levers *d*, *d*, working at *e*, *e*, on their centres or stud brackets at *e*, *e*, which form pivots, said brackets or carriages being bolted under bed plate. The other end of bell cranks, *d*, *d*, are connected by pins at *g*, *g*, to forked connecting rods, *h*, *h*, the upper ends of which are connected to main (B, B,) and minor shaft (B^1, B^1,) crank shafts by metal butts and straps.

The object of this lever adaptation is that when

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No. 1 ram is propelled out from its cylinders it presses, by means of the lug and pin fastened through lever D, upon the said lever, which, being thus driven forward, the lever draws the horizontal connecting rod *e*, bell-crank lever *d*, and forked connecting rod *h*, backwards, the necessary distance to obtain by this movement a half throw of main crank driving shaft B, B, and thus causing a half revolution of said crank shaft. This accomplished ram, No. 2, moves forward instantaneously in like manner, and No. 1 retires. The forward pressure of ram No. 2 drives the lever D, and the lever attachments thereof in like manner to No. 1, and thus causes, by means of its half stroke, the second half revolution of the main shaft, thus completing the revolution. On centre of main shaft is keyed the fly-wheel E, which revolves through a slot in the bed plate performing its revolutions. At base of ram cylinders 1 to 4 are screwed in the plunger cylinders 5 to 8, and on top of the ram cylinders at H are moveable cup reservoirs H, which fit into screw holes drilled in the metal communicating with the interior of the cylinders. These cups are of glass, to allow the charge of water in the cylinders to be gauged, and contain self-acting valves, by which any deficiency may be replaced.

When the cylinders are filled with water, these cups are screwed in and also filled with water; a metal cap is then placed on the head. Pump-plunger cylinders, 5 to 8, consist of hollow cylindrical tubes, and in them, moving through stuffing boxes, work solid metal pump plungers 18. Each series of pump plungers are united by cross heads *k*, in the centre of which are screwed guide rods *l*, which work through guides *m*, bolted to bed plate, and attached to forked connecting rods applied to the minor crank shaft B^1 by butts and straps. The revolutions of the minor crank shaft B^1 are caused by the working and pressure of the rams 3 and 4, the pressure of these rams being communicated by a similar lever arrangement, as described of rams No. 1 and 2. At each revolution of the B^1, upon which is keyed the fly-wheel P, each half throw drives inwards the pump plungers 5 and 6 of rams 1 and 2, and as the pump plungers descend in their cylinders they press forward and eject under the base of the rams 1 and 2 the water which was contained in each, and as this water presses upon the base of the rams by the descending of the pump plungers to the end of their stroke, so in proportion the rams press forwards, upwards, and onwards, conveying the augmentation of hydrostatic power thereby generated upon the levers, causing, as before described, the rotation of the main crank shaft B, B, whereby wheels attached thereto are driven. Parallel with the end of the pump plungers 5 and 6 of the rams 1 and 2, and with a space intervening, are bolted down upon the bed plate the series of pump plunger cylinders 7 and 8, fastened into the base of the rams 3 and 4, also bolted down upon the bed plate. At the cross heads *k*, *k*, of the pump plunger cylinders 7 and 8 of the rams 3 and 4, there are screwed on lugs *r*, slotted out to receive the upper end of forked levers S, which oscillate upon pins at *t*, *t*, placed through the centre of the lugs. The fulcrums of the forked levers work upon studs fastened at the base angle of hanging brackets bolted under bed plate. The upper forked ends of the levers by their pressure forward drive by their alternate action inwards the pump plungers 7, 8, which in their stroke eject from their cylinders the water contained in each under the base of the rams 3 and 4, which press forward in manner as before explained upon the minor crank shaft B^1, which again performs its office. The levers S, S, which work in brackets fastened under bed plate, thereby giving pressure upon the cross-heads *k*, of the pump plungers 7 and 8, are driven backwards and forwards, thus pressing and retiring after delivering each stroke, by the action of two connecting rods running under bed-plate, which are fastened to the levers S, S, and which work horizontally and parallel to each other beneath the bed-plate. At the other end of the connecting rods they are attached to the double throws of an auxiliary crank G. Upon the end of this crank shaft is fastened a V-grooved wheel B^3, in which works a gut band connected with an outside foreign power, by means of which the engine is set in motion. On the main crank driving shaft B, B, is keyed a double V-grooved wheel e^1, upon the minor crank shaft B^1, and upon the auxiliary crank shaft are also keyed single V-grooved wheels, the three V pulley wheels following in vertical line with a gut band passing round each, by means of which is maintained harmonious action, and alternate movement between both systems of rams, and pump plungers, thus also equalising and obviating loss of time between each throw of the respective cranks; and further by this application an equitable upward and downward movement is given by the working of the engine itself to the pumps, levers, and other portions, without the necessity of regulating the same by hand power. There are other ways and means of utilizing the power acquired, which it is not necessary to describe in connection with the engine illustrated. The engine is set in motion by the rotation of the V-grooved wheel which is attached to the auxiliary double throw crank shaft, which pulls backwards and drives forwards alternately the levers which work by their forked heads in the lugs of the smaller series of pump plungers screwed to the cross heads, thereby pressing by their levers alternately upon the pump plungers which are driven to the end of their cylinders, ejecting as they descend the water from them under the base of the rams, whereby the rams alternately press forward by the intervention of their levers upon the cranks of the minor crank shaft, giving to it half circles, and by the two throws completing the revolution of whole circles, the cranks in those half circle revolutions press alternately upon the guiding rods, lugs, and cross heads of the series of pump plungers attached to the larger series of rams; thus conveying on those pump plungers the entire of the augmented hydrostatic force generated and produced by the pressure of the small series of pump plungers upon the bases of the lesser series of cams before alluded to. This increased force pressing upon the bases of the major series of rams, drives forward upon the levers thereof the whole force, and thereby the cranks of the main driving shaft rotate upon their axles, and by that means communicate the hydrostatic power for the driving wheels and all manner of machinery, and ensuring continuous rotary motion.

ANSWERS TO CORRESPONDENTS.

Our correspondents will observe the pruning knife is often used on their communications: will they kindly spare us the trouble!

J. O.—Will see we have stopped the subject. He will find the matter treated on already. Were we to answer the many inquiries by post, we should have no time for aught else.

JUAN.—The languages are English, French, German, Italian and Spanish. You inquired some time since respecting, sugar; if you will send for Spon's new catalogue, you will find something there to interest you.

JOHN THOMAS.—Will endeavour to meet your requirements.

JUST IN TIME.—Weale, Lockwood, and Spon's catalogues. Send your address, and request for a catalogue. Thanks for your letter.

DELTA.—Very hard to say how much, but certainly not more than half of the power generated.

GREGORIUS.—The idea is good, but we think a rather roundabout way of increasing the power. Yet in certain situations and conditions, which you evidently are aware of, the gain would be about 35 per cent. Do you think it would pay you to go on? Paper destroyed.

THOMAS WOOD.—You are quite correct. It is an American "claim," and was not noticed by us before sending to printer.

A. B.—Can't give you prices. Chipperfield and Messent, 8, Newgate-street; John Lever, Size-lane, Bucklersbury; Partridge and Cozens, Fleet-street.

ASPIRANT.—The subject you speak of is important, and will receive attention. It has been announced by us among our usual "notices."

AMATEUR.—Comical, stupid, aggravating error.

J. NEWTON.—Too late; next week.

INVENTOR.—Will give it a thought this, and answer next week

MAGNETISM.—We were told by a Manchester man the other day, that he and many others took it to get a look at any ideas coming out. This would suit you; but be careful how you go to work. We heartily wish you success; and —let Glasgow flourish.

APPRENTICED MECHANIC.—Only fig 2 come to hand. You send fig 1, we will insert it for you.

W. BATTY.—No room for the matter.

R. C.—The work is we believe in German, and may be obtained through Trubner and Company, booksellers, Paternoster-row.

APPRENTICE.—See our next: lack time this week.

TURBINE.—Your turbine, were there no waste, would consume as near as possible 8·8 cubic feet of water per minute. As perfection of use has never yet been obtained, you would, as the useful effect is not much more than 60 per cent., require a supply of over 13 cubic feet per minute. The horse-power is equal to 500 lbs. falling 66 feet; and to get a horse-power out of your 60 feet fall, 550 lbs. of water must fall per minute. The cubic foot of water weighs 62·5 lbs.

CHEMICUS (Derby).—1, Wine Office-court, Fleet-street; weekly price, fourpence.

JOSEPH SLATER.—Your question has been answered more than once. The invention is claimed by many.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

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The English Mechanic.

FRIDAY, SEPTEMBER 29TH, 1865.

PATENT RIGHT AGAIN.

IT was not to be supposed that the opportunity or the British Association meeting would be neglected by those anxious to upset Mr. Woodcroft's and the Commissioners of Patents' vocation—by, what they have themselves elected to be called, the Freestealers of the day; and it was known for a short time previously to the meeting, that Mr. Rogers, Professor of Political Economy, Oxford, had braced himself up for the attack on patent rights, backed by Sir W. Armstrong, and Mr. Vignolles, C.E. But Oxford generally has been distinguishing itself of late, in a manner qualified to astonish its friends and well-wishers. It has done a trifle in Parliamentary distinction, in the case of Mr. Gladstone; and, as the yellow leaf shows by the hedge, it tones down into advocacy of Freestealing. Mr. Rogers is, we are told, a representative man—we are sorry, then, that he has given way to the company of "appropriators," the more so that we greatly respected him when he wrote so fluently in favour of copyright—and of course against Freestealing. We were glad, then, to hail one who, by sheer pluck and hard endeavour had reached an elevated position; our grief now is correspondingly lachrymose. It requires a stout heart to face a "stey brae;" on the other hand we may quote an old and true saying, which begins "*Facilis descensus.*"

But, however great and marked may be the fall of Mr. Rogers, he shall drag no one down with him to whom we can be of assistance—and not one inch

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shall we budge from our original stand point, notwithstanding his windy oration at Birmingham. We maintain that a man has a right to that protection from the law which will enable him to realise a compensation for the labour of his brain—the equivalent to the nation being the use of that brain's progeny; that it is the duty of the parent government to provide this protection; and that what we want now is, not the abolition of the patent laws, but the alteration of them, so as to provide for all the greatest amount of protection and benefit at the lowest possible cost. Birmingham owes its great success as a manufacturing centre to the patent laws, and those who are most concerned in the success of the grimy town freely concede this. Mr. Bessemer, the Great in Steel, has stated, we believe, that had he not seen his way to fortune through the doors of the patent office, his labours would never have been protracted to the extent they have been; and, however great may be the love of his kind in any man, we are sadly afraid that were a person of an inventive turn of mind once satisfied that the fruits of his inventions would go principally to the enriching of capitalists—the barren honour only falling to his share—he would cease to usher into the world the creations of his intellect. It is not a case of free trade *versus* protection—it is one simply of private property.

But we have not space to comment further on the matter. Our business is with Mr. Rogers. He has put himself forward as the Freestealers' Champion—and in this last round has failed to come to time. True, he had Mr. Vignolles as his second; but Sir W. Armstrong, great in guns, and strong in coal predictions, was conspicuous by his absence from the field. Having failed here, it is to be hoped that in the ensuing Parliament the failure may have its weight, and honest men their due. We do not mean to insinuate that the worthy Professor is not honest in his course; he is too much of a gentleman to be aught else; but he has turned coat, and that is a damning argument against him. Let the law be altered—Patience knows they sadly require it; let the fares on the turnpike to—fortune?—be altered; and sufficient will have been done to enable us to go on, inventing and making ourselves a name, for the next fourteen years.

ON THE CAUSE OF THE VIOLENCE OCCASIONALLY ATTENDING THE EXPLOSION OF STEAM-BOILERS.

Few questions of practical science are surrounded with greater mystery than the cause of the violence with which boiler explosions are sometimes accompanied. If a comparative degree of violence was at all times associated with the explosion of boilers, no doubt the cause of the explosion itself could be ascertained. This, however, does not happen to be the case. By far the greater number of boilers are destroyed quietly, and without any greater manifestation of violence than if they were simply burst open by cold hydraulic pressure. This seeming paradox of explosions occurring under the two opposite conditions has involved the whole question of boiler explosion in uncertainty. It is a singular fact that the more dangerous and formidable explosions have been known to have taken place in boilers while at their ordinary working pressures, whereas one would generally be led to consider that, except in cases of undue pressure, or some inherent defect in the construction of the boiler, no explosion could come to pass. The majority of ordinary boiler explosions which occur unattended by any great amount of percussive force or detonation are induced, no doubt, owing to some defect which is unobserved during the construction of the boiler, or which becomes developed while the boiler is in process of working. It is surprising, however, to reflect that at least seven out of every ten boiler explosions which take place are put down to some entirely metaphysical and unexplained cause. Leakage is, of course, a very frequent forerunner of these catastrophes; but the forms under which leakage itself takes place are very numerous. Although few have been investigated with so satisfactory a result as could be wished, they are sufficiently marked to lead to the conclusion that their causes are very different. Vibration of the boiler in its bed, by causing some change in the molecular arrangement of certain parts of the boiler, may often lead to openings along the rivet seams, or in the plate itself, which afterwards become enlarged to full and developed leakages. When the water once finds a flow through the narrowest channel, it begins a scour upon the sides of the opening, tending to widen and increase the flow, and when the air is reached a combination sets in between the metal, and the oxygen contained in the water forming an oxide which is continually washed away by the force of the escaping water.

The orifice then becomes widened by successive corrosions of the surfaces, while a steady oxidation sets in on all the surrounding parts. The same class of phenomena are also more or less associated with steam leakages occurring above the water line, only that in this case the growth of the leakage would be accelerated, as the abrasion of the escaping steam would operate upon the surfaces of the metal with more force than a leakage of water. This does not take place at first. Owing to the comparative freedom of steam from oxygen, very little decomposition of the surface of the metal would take place unless in the case of a leakage of long duration, as the hydrogen of the steam absorb the oxygen from the air as soon as it meets with it in the course and direction of its escape. When condensation sets in round the leakage, oxidation commences, and the leakage is consequently rapidly extended. Probably in boiler engineering the various forms of leakage, and more especially those which result from vibration, do not meet with so much attention as they deserve. The familiar noise produced by a kettle may be heard upon a much more extensive scale in the case of a good-sized boiler in which the steam is being got up. In the one case the waves of vibration succeed each other so rapidly that, like the revolution of the prismatic colours on a disc, although they may not be in every respect the same as to duration and force, but a single impression is conveyed, being that of a uniform and prolonged sound. In the case of the boiler these vibrations assume the character of trifling concussions, each of which is perfectly distinguishable from those that precede or follow it, and very frequently these minute and innumerable shocks effect a serious modification in the material of which the boiler is formed.

There is besides a constant circulation, as is commonly known, of the water in all boilers, tending to produce a great amount of vibration. This operates in oblong boilers, causing a current in the direction of their length from the front end to the back, and in other classes of boilers in a direction, of course, varying with their form. The velocity and force of this current differs with the quantity of water contained in the boiler and the intensity of the heat used to effect its conversion into steam.

This is a serious and frequent cause of boiler destruction, for it must be remembered that when a certain heat is attained both in the steam and in the furnace, and corresponding conditions are established between the heat of the boiler itself and the atmosphere that surrounds it, a sort of communication is established between the internal and external atmospheres, and it is owing to the want of a fuller knowledge of the phenomena which transpire at this crisis, probably, that many disastrous cases of boiler explosion may be fairly attributed. In boiler ruptures, caused simply by the expansive force of steam, it would seem as if in some cases gases of which steam is composed possess a force of adhesion, or combine with such strength after they have attained a certain degree of electricity, that they do not operate in an inferior direction, but accumulating their force beyond this pitch they wait until they encounter some more formidable obstacle, and in a moment everything is hurled on to destruction by the fearful violence with which they become disengaged. The proximate cause of boiler explosion is yet involved in great obscurity. It was considered by Dobereiner, that chemical combinations and decombinations could be effected through the medium of the closest textures of iron, or other bodies, by simple capillarity, but the results attending the operation of caloric, light, and acidity are such that human ingenuity can scarcely hope to arrest them, however successfully such results may be provided against. The atmosphere where it comes in contact with the external surfaces of a boiler plays a much more important part than may be held generally to be the case. A boiler well heated and producing a good steam may be compared to a cylindrical body trying to hold all its parts together between two equally balanced forces which tend to separate them, by pressures acting in contrary directions. Whatever may be the subtle nature of the phenomena by the operation of which water becomes converted into steam, it is clear that a reciprocal change is continually going on between the atmospheres inside and outside the boiler. Besides its effective work in giving motion to the piston of an engine, steam operates very powerfully in another direction. The entire movements of an engine are due to the momentary diversion of steam force, from the more natural way in which it would seek to expand or set itself free. This it is always attempting to do except at the intervals when its force relaxes under a momentary but abnormal liberation into the cylinder. The true direction of steam is away from work. It has been found by recent experiment, that there is no class of metal so compact or homogeneous as to be altogether free from percolation, or the molecular structure of which would separate it from those that are known to be porous. Carburetted hydrogen passing through an ordinary iron gas pipe, although having a force of direction given to it, may be adduced as an illustration. Before the gas reaches the extremity of the tube not only will the hydrogen have exuded between the molecules of the tube, but other and entirely different gases will have entered and assumed its place. Thus, unless there is always a strong flowing current of gas, an explosion in exposed gas mains would be always imminent when a flame was brought near any opening made in them during the time of their being tapped, or bored for connections. When the current of gas flowing through them is strong the danger is diminished.

It has been stated by some writers on boiler engineering that a continual change of pressure is taking place in the boiler, owing to the variation of the load put upon the engine, and that very little difference arises regarding the working of the boiler itself when once the steam is fairly up.

Morosi was of opinion that on the stoppage of the piston at each end of its stroke, the whole force of the steam was so violently arrested as to cause it to strike back suddenly into the boiler, and burst it open. Now, it is obvious that wherever a force operates upon a fixed and immovable body, it reacts upon itself; and this must be, in a certain measure, the case with steam issuing from a boiler. But the causes which lead to variable pressures in the force of the steam are much more numerous at the seat where the steam is generated than those resulting from a difference in the working load of the engine. The phenomena of steam generation has been, perhaps, too much overlooked in regard to boiler explosion. The leakages of steam are not so numerous as the leakages of water in boilers; or where water is the resisting body, and steam the force, the force will operate by preference. It will not yield or escape unless it be impossible for the water to escape, and, in this case, the resistent then becomes the force. A thermometer inserted in water passes through certain localities in which heat has taken up a situation, until it assumes the form of a globe, and ascends. It is known that these localities cannot be spherical. The chief difference between fluid and solid bodies is that the former are more or less spheroidal, while the latter are more or less crystalline. The points of contact between three circles would enclose a space which, when reversed, would form a circle, and it is so with globes. Their points of contact are so arranged that the spaces left within them would constitute other globes of the boundaries of these spaces where placed in convexity instead of being concave. Thus convexity and concavity is to the material what life and death is to the moral world. It is manifest that such must be the order of the aggregation of water that this sphereidal condition is presented, and that heat enters and converts the spaces into globes within which it remains and ascends. There is no other situation in water that heat could occupy, for if any combination took place, there would be no useful effect, no violent ebullition. Water would no longer conduct heat vertically any better than it does longitudinally, and it is only when heat passes up through the water into what is called the steam space that the true action of heat on the water commences. The condensation of the air in the steam space then becomes so accelerated, that at last it reaches an intensity that will not admit of its being safely confined F. M

(*To be continued.*)

MANUFACTORY OF LUBRICATING OILS.—The firm of Morehouse, Merriam and Co., of Cleveland, Ohio, manufacturers of compound lubricating oils, now turn out from their factory from four to five thousand gallons a day, and have capacity, if pressed with orders, to produce double that amount. They give employment to about fifty hands.

FRENCH AND ENGLISH MANUFACTURERS.—The *Courrier au Bas Rhin* has the following paragraph:—"We learn a new victory of the construction of French machines over the English, and this time it is in Alsace that the machines will be constructed. The Baden Government lately invited tenders for 46 railway locomotives. The English offered to build them for 70,720f. apiece; some Baden manufacturers asked 55,720f.; finally, the Gatffenstaden (French) works asked only 45,000f. This last competitor had its tender accepted for 22 locomotives; the 24 others were adjudged to the Badeners, and the English got nothing, on account of their price being so high."

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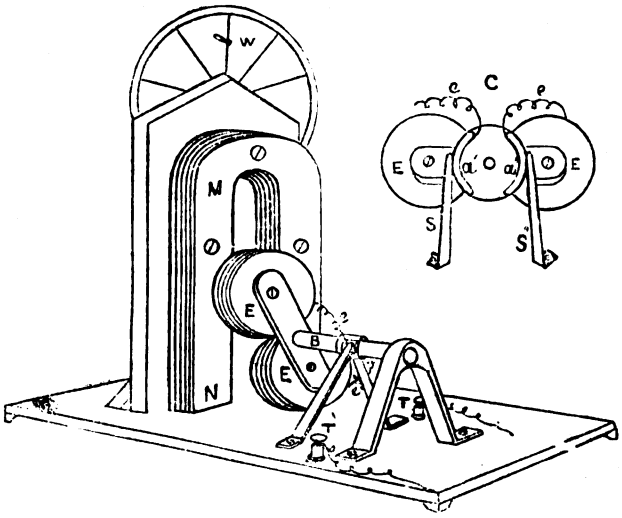
LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

[With the letters on the subject that appear in this week's number closes the correspondence on Electricity, and the matters growing out of it; more space we cannot afford. Many correspondents have not been noticed, as their requirements had been treated of in previous numbers, and numerous letters have been denied admission, they being, in many cases, repetitions. We cannot help venturing the expression that in no other instance has there been so great an interest shown on any single subject as on this. To the various contributors we tender our own and the thanks of all our readers for their kindness and hearty co-operation; and, in the next subject of importance put forward for discussion, we hope to have as copious and energetic support. The more brief the communication—consistent with value—the better chance will it have of insertion. We would suggest the matter of working tools, in any profession, as a fit matter for discussion.]

MAGNETO-ELECTRIC MACHINE.

Sir,—Further particulars being required relative to the construction of magneto machines, in addition to the rough outline already given by me, I beg to hand you a sketch of one:—



M is a compound steel magnet 10" high × 2" × 2½" in breadth, fastened to a standard of wood, E, E, the revolving horse-shoe electro-magnet fitted on spindle B. The wheel W is connected by an endless string to a groove on the spindle; on turning which, a very rapid rotatory motion is communicated to F, F.'

At each revolution four distinct currents are set up, viz., two on approaching, and two on receding from, the poles of steel magnet; the former being comparatively weak, are destroyed, and the two latter caused to flow in one direction. To effect this a commutator is used, consisting of a cylinder of wood, A, on which are fastened two insulated strips of brass, a', a'', arranged opposite each other, with upright springs s', s'' alternately resting against the brass and insulated portions. The ends of wires e', e'', are fastened to these brass strips.

C is a sectional view of a commutator so made.

When the revolving electro-magnet approaches the poles of steel magnet, the upright springs press against the wood, or insulated portions of cylinder, thus preventing from passing, and rendering useless the currents set up. On it receding from them, the upright springs are brought in contact with the metal portions of cylinder, allowing the currents to pass out of insulator.

To any one acquainted with magnetism it must be apparent that the current set up in the coils of revolving magnet, when proceeding in a direction away from N-S of steel magnet must be reverse to those generated on its leaving S-N, on account of opposite polarity; but this cannot affect the direction of the current in any part of the circuit beyond the instrument, because every change of position on the part of the electro-magnet necessitates a proportionate change in the position of commutator, or current reverser; for instance, if the helices be wound in a right-handed direction, commencing at e', on the electro-magnet receding from N-S, e' will possess the properties of a positive pole, and e'' that of a negative pole of a battery, and as a', a'' rest respectively against s', s'', the currents passing out by these springs assume the same properties. When, however, the electro-magnet recedes from S-N of steel magnet, the current at e will resemble a negative, and at e' a positive pole; but since a', a'', now rest respectively against s'', s', the currents passing out by the springs to the terminals T, T, are of the same name, as in previous case.

The current produced by magneto machines, although intermittent, have all the appearances and properties of a continuous current, owing to the great rapidity with which they may be caused to follow each other.

Such an instrument as I have here described will answer the requirements of your correspondent "Magneto-Electric Machine."

If the revolving magnet be coiled with several thousand turns of very fine wire (No 40), the results obtained will be analogous to the high tension currents of a Rhumkorff coil.

If it be coiled with about 50 or 60 yards of stout wire (No. 12), currents of great quantity are obtained, capable of fusing short lengths of fine wire, or if passed through charcoal points of producing a small electric light.

ELECTROTYPING BY MAGNETISM.—For electrotyping I should recommend "Henry Watson" to coil the magnet with about 50 yards of No. 22 copper wire; but a smaller apparatus will perhaps suit his purpose equally well if his operations are on a small scale.

The instrument must be joined to the decomposing trough in same way as with a voltaic battery: the article to be electrotyped must be joined to the terminal resembling the negative pole, and the plate of metal to the positive pole. Both the plate and article to be electrotyped must be immersed in the decomposing bath.

It may happen, through an error in coiling, that the current passing out by the terminals T, T', will become reversed; it will therefore be an advantage to be able to distinguish the positive from the negative pole; this may be easily done thus:—Connect a bright wire from each of the terminals, and place the two ends in a glass of water near each other, but not in actual contact. On putting the instrument in operation, one of the wires will become oxidised; this will be the positive pole, the other the negative. Or if a galvanometer be at hand, the two wires can be joined in circuit with it, and the direction of the deflection noted. Compare this deflection with that shown on it by a voltaic battery.

EDWIN FURZE.

ELECTRICITY, &c.,

In reply to W. S. S., he will find "Russian Glue" suit his purpose for applying emery to glazers. "Magneto-electric" will find his question answered by Mr. E. Furze in No 23, and I quite agree with that gentleman that the commutator is a hopeless case with a mere verbal description; it must be seen to be understood.

I should strongly recommend Mr. H. Watson to construct about six cells of Daniell's battery, small ones will do, and then he will have a cheap, efficient, and lasting means of electro-plating, for which purpose the magneto-electric machine is not adapted, nor do I think it can be as a commercial success, and I think few amateurs would like the constant imitation of organ grinding it would entail upon those who wished to employ it experimentally.

In reply to "Steam O!" some few years ago, Mr. W. Fairbairn, of Manchester, conducted a very elaborate series of experiments upon internal and external pressures upon tubes, using glass as being the most homogeneous material at his command. As the result of these experiments I think he somewhat startled the engineering world by stating that a tube would bear seven times the pressure internally that it would externally—hence "Steam O!" will perceive that in order that his boiler should resist the atmospheric pressure when a vacuum is formed inside, it should be made strong enough to bear 105lbs per square inch steam pressure.

"Amalgam" must dissolve sealing-wax in methylated spirit, or, which is better, if easily procurable, in naphtha. This is done more readily by pounding the sealing wax in a mortar before adding the spirit and applying a gentle heat while the wax is dissolving. Make it about the consistency of ordinary paint and apply it with a brush; it will soon harden.

"Felix" has been "happy" enough to find a different solution to the "cistern question," from that given by C. T. Whitmell, and myself, and W. Bradbury agrees with him. I thought the object was to find a correct solution, not one that should differ from another. If mine is wrong I pray you, "Felix," shew me where; but the propounder has not yet stepped forward to say why his cistern leaks by night, and not by day, and that is a matter of greater import than even the solution of the question itself, for upon it rests the momentous question as to whether the cistern could ever be filled.

As I never happened to have a work on electricity in my possession save a few numbers of the "Electrician," I most willingly bow to the correction made by Mr. E. Furze in the ratio of resistence between iron and copper, since "Becquerel" is an authority in the science; this admission will, however, affect the conclusions I have arrived at and placed before your readers, not in their substantive accuracy, but simply in the amount to which they extend.

There is a paragraph in your No. 24, page 285, which I think requires a little light thrown upon it. The subject is "Experiments with the Magnesium Light." Great credit is bestowed upon Capt. Bamber, R.N., the whole of which he is no doubt entitled to receive but the paragraph says "The burner is enclosed by a powerful lens or bull's eye glass which has the effect of not only magnifying the light, but of materially intensifying its rays." Is this true? or is it a "lapsus penae" of your correspondent who witnessed the astonishing phenomenon? That a lens will concentrate the rays of light is an optical law, but I am sadly at a loss to understand what combination of certain molecules of glass should succeed in not only magnifying but actually intensifying the rays of light transmitted by them.

WM. TONKES.

[Mr. T. will observe we have given place to another correspondent as to part of his answer. Reason—first up in type. The "lapsus" referred to was inserted unwittingly: an oversight.—ED. *E.M.*]

Sir,—A Goldsmith (No. 23), apparently confounds an induction coil, with a magneto machine—under such circumstances, it would have been a matter of surprise had he met with success in coiling both helices continuously in one direction. If the instructions given by "Electra" and "W. Tonkes," had been followed out, I feel certain no difficulty would have occurred. E. FURZE.

Sir,—In answer to a "Young Mechanic," in No. 24, the small electric machine described by "R. Booth," No. 15, will answer for giving shocks; but, like all other friction electric machines, it must be in conjunction with the Leyden jar.

2. He can obtain a glass cylinder as described at the electrician's or optician's shop.

3. Any metal wire will do for the points of the conductor; but mine are made of brass.

4. The number of wire points are not particular—say four or five for a machine that size.

5. Common tin will do as well as tinfoil for the conductor; but the edges, when the tin is joined, and also the ends of the conductor, must be filed smooth, or the electricity will escape from any point or asperity.

6. The wire points must be fastened on the conductor by solder, or otherwise to within a short distance of the glass cylinder—say quarter inch.

7. The following is a recipe for the cements to fasten the glass rod to the conductor: 5 lbs. resin, 1 lb. each of bee's wax and red ochre, and 4 oz of plaster of Paris. These should be melted together till the frothing ceases, and the composition runs smoothly.

8. The wire at the end of the conductor with the knob to it can be of any length; but 3 or 4 inches would be likelier than 3 or 4 yards.

9. Any kind of paint will do to paint the machine with, or it will do without painting.

"Amalgam" can cover the ends of an electric machine with sealing-wax by dissolving the sealing-wax with a gentle heat in spirits of wine, and applying it in the same manner as paint with a brush. J. WATSON.

We add the following extracted from an answer almost similar to the above:—

"(9.) The wood-work is best if French polished. The ends of the machine may be varnished. Make your varnish thus:—Break up some sealing-wax into small pieces and place them in a phial; pour on them either alcohol or wood naphtha. Keep it well corked, or the spirit will evaporate. Apply it to your work with a small brush

If "Mechanic" wants more information, address a letter to J. BACON.

Madeley-street, Rose-hill, Derby.

Sir,—For calculating the natural sines of angles:—If "Fentonior" wishes to investigate the subject, he will obtain much valuable information from Hutton's Course of Mathematics—article, "Analytical Plane Trigonometry." If he only requires the natural sines for any mathematical process, then purchase "Chamber's Education Course," price 3s. 6d. Or, if he has a table of logarithmic sines in his possession, the "natural" can easily be deduced from them by deducting ten from the index of the former. This gives a logarithm the number corresponding, to which is the natural sine required.

In reply to his second query, the square of the chord of any arc is equal to twice the rectangle under the radius and the versed sine.

"Induction Coil" can use gutta-percha-covered wires for his primary, provided the covering is very thin, since the tension is not very high; but if the wire is thickly coated, it will make the coil cumbrous, and remove the secondary too far from the central core. With regard to the use of the condenser, I do not think it could be more clearly laid down than by the editor of the "Electrician." In the first of a series of papers upon the subject (Vol. I., p. 184), he says:—"The intensity of the inductive effects in the secondary wire, or the rapidity with which the electricity accumulated in this conductor, is liberated in a static form, is obviously dependent upon the instantaneous character of the inducing causes in the primary wire. The prolongation of the battery current by a current of induction in the same direction diminishes, therefore, the effects of induc

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tion in the secondary wire when battery contact is broken. When a magneto-electric effect is produced by the insertion of a fasciculum into the axis of the coil, the induced current in the primary as well as in the secondary, is augmented.

The importance of the condenser which accumulates on one of its coatings the electricity of the induced current, which otherwise would traverse the primary wire, may thus be appreciated."

"A. Crofts" will find rather an improvement than otherwise, so far as the intensity of current is concerned, by the alteration he refers to; but his outer vessel must be either porcelain or common brown ware, a cylinder of sheet zinc being used, sufficiently large in diameter to leave ½" all round the porous cell. The copper only need be a flat strip, bent thus the part *a* forming a shelf for the crystals of sulphate; a little more care is, however, required in this arrangement, as endosmosis takes place more rapidly, and the porous cell is apt to become too full and overflow into the outer cell, ruining the zincs. As I stated in a previous letter, these two "Moseses" are the greatest sources of evil in all battery arrangements where porous cells are used, save in the "Marie Davey." The best cells I have found yet in overcoming this evil are those made at the Imperial Potteries, Lambeth. A Daniell's battery coupled for intensity, and using acid, will not keep in good action for much more than a week with any arrangement. W. TONKES.

[No room this week for remainder.]

FLOATING BODIES.

Sir,—With regard to "Novice's" illustration of the board and bullets, I have only to say that as bullets are neither a fluid nor a liquid, the board will not float.

An inflated balloon presents three peculiar features, viz., the great care taken to prevent its untimely departure by being strongly tackled to the ground; the rapidity with which it darts from the ground, as if impatient to get away from the habitations of man; and, though last, yet not least, the higher it gets the slower is its upward progress.

In looking for a cause through which the foregoing effects may result from, I find two forces continually in operation, viz.,—the force of gravity and centrifugal force, which latter force results from the earth's rotation on its axis, and which I to believe is the cause of bodies floating.

While considering the floating of a balloon, centrifugal force may be objected to, seeing the machine is away from the surface of the earth; but it must be borne in mind, our very atmosphere is obedient to the law of gravity, and is carried along with our planet round the sun in its orbit, and so long as the machine remains within it, it will be under the action of these two forces.

Viewing it then in this manner, I can account for the cause of its being strongly tackled to the ground; and, as centrifugal force is strongest at the surface of the earth, I can see the reason why its upward speed is at its greatest. Immediately on its being liberated, that speed will gradually decrease until a point is reached. Where centrifugal force and gravity balance each other, it will then float in equilibrium, which can only be disturbed again by reducing the quantity of matter contained in the machine, when the preponderance will again be in favour of centrifugal force, thereby enabling it to rise to a greater height.

Before concluding my letter, I may mention that a former correspondent spoke of specific gravity combined with the pressure of water or air as the cause of bodies floating; but specific gravity is not a force. I consider it merely as a preparatory step to allow centrifugal force to make a visible effect. WM. AIMER.

[This matter must now be considered closed.]

THE MANUFACTURE OF CAST STEEL.

By H. BESSEMER, ESQ. *

The paper opened with a review of the inventions which had finally resulted in the establishment of "Bessemer" Ironworks throughout the country. It pointed out at some length how the disadvantage of the old fixed converting vessel was remedied, and other improvements introduced. Up to this period the manufacture of cast steel by the old as well as the new process was still so far imperfect that steel of the highest quality could not be made from inferior iron. In 1839 the trade of Sheffield received an enormous impulse from the invention of Josiah Heath, who patented in this country the employment of metallic manganese, or, as he called it, "carburet of manganese." The addition of a small quantity of this metal, say from ½ to 1 per cent., rendered the inferior coke-made irons of this country available for making cast steel. It removed from these inferior qualities of iron their red shortness, and conferred on the cast steel so made the property of welding and working soundly under the hammer. Mr. Heath supposing himself secure in his patent, told his licensees that if they put oxide of manganese and cold tar or other carbonaceous matter into their crucible along with the blister steel it would do as well and be much cheaper than the carburet of manganese he was selling them; in effect, it was the same thing, for before the steel was melted the carbon present reduced the oxide of manganese to the metallic state, so that the patent carburet of manganese was formed in the crucible in readiness to unite with the steel as soon as it became perfectly fused. But the law decided that this was not Heath's patent, and so the good people of Sheffield, after many years of litigation, were allowed to use it without remuneration to the inventor. Manganese had now been used for many years in every cast-steel works in Europe. It mattered not how cast-steel was made, since manganese added to it necessarily produced the same beneficial changes. No one appreciated the fact better than the unfortunate Mr. Heath, as evidenced by his patent of 1839, in which he declared his invention consisted in the use of "carburet of manganese, in any process whereby iron is converted into cast-steel." Had Heath seen in his own day the Bessemer process in operation he could not have said more. With this patent of Heath's expired, and become public property, coupled with the universal addition of manganese and carbon to cast-steel, it would naturally be supposed that the author, in common with the rest of mankind, would have been allowed to share the benefit which Heath's invention had conferred on the whole community; but it was not so. The reading of the author's paper on the subject, at Cheltenham, in 1856, led to great expectation as to the value of the new process, and licences to manufacture malleable iron, under the patent, were purchased by ironmasters, to the extent of £25,000, in less than twenty-five days from the reading of the Cheltenham paper. Great excitement existed at the moment in the iron trade, and many persons seem to covet a share in an invention that promised so much. There was consequently a general rush to the Patent Office. Some of the gentlemen who applied even repatented some of the writer's own patents, while others patented things in daily use, in order that they might be considered new, when added to the products of the new process. The paper described the features of the numerous patents applied for within six weeks of the reading of the paper at Cheltenham, and remarked that if that long series of patents could have been sustained in law it would have been utterly impossible for the author to have employed manganese with steel made by his process, although it was considered by the trade to be impossible to make steel from coke made iron without it. Soon after the reading of the Cheltenham paper several rough trials of the Bessemer process were made privately, by persons in the iron trade, and defects discovered which were supposed by practical men to be perfectly fatal to the invention. The press then spoke of the utter impracticability of the process, and of regrets that the high expectations originally formed were so fallacious; but the storm gradually subsided, and the process and its author were soon entirely forgotten. Imperfections in the process there certainly were, but the author had had the most irrefragable proof of the correctness of the theory on which his invention was based, and also that the reasoning on which it was so utterly condemned by the trade was in itself wholly fallacious. He therefore decided not to argue the question against a hundred pens, but to energetically prosecute his experiments, and to remain silent until he could bring the process to a commercial success. When at the expiration of three years of incessant labour on the part of himself and his partner, Mr. Longsdon, and an expenditure of more than £10,000, the process was again brought before the public, not the slightest interest was manifested by the trade. This was discouraging, and one of two things became imperative; either the invention must be abandoned, or the writer must become a steel manufacturer. The latter alternative was unhesitatingly accepted, and Messrs. Henry Bessemer and Co. determined to erect a steel works at Sheffield, in the very heart of the stronghold of steel making. At these works the process had ever since been successfully carried on; it had become a school where dozens of practical steel makers received their first lessons in the new art, and was the germ from which the process had spread into every state in Europe, as well as to India and America. By the time the new works at Sheffield had got into practical operation the invention had sunk so low in the public estimation, that it was not thought worth paying the £50 due at the expiration of three years on Mr. Mushet's large batch of manganese patents. They were consequently allowed to lapse, and become public property. The author had therefore used without scruple any of the numerous patents for manganese without feeling an overwhelming sense of obligation to the patentee. At the suggestion of the author, works for the production of manganese and alloy were erected by Mr. Henderson, at Glasgow, who now made a very pure alloy of iron and manganese, containing from 25 to 30 per cent. of the latter metal, and possessing many advantages over Spiegel Eisen, which it would doubtless replace. Specimens of iron manufactured by this process and afterwards bent and tested in every way, were exhibited on a table in the room. The paper proceeded to notice some of the more important applications of steel as a substitute for wrought iron. In no case, it was pointed out, was this change of material more important than in the construction of ships, for in no instance were strength and lightness more essential. Bessemer cast-steel ship plates were then described, and their advantages illustrated by facts and statistics. The advantages had not escaped the attention of Mr. Reid, the talented constructor of the navy, and they should doubtless soon have substantial proof of what might be effected by the employment of steel in the construction of ships of iron. The application of steel to projectiles was next considered. Next its uses for railway purposes, such as the manufacture of engine cranks, axles, tires of wheels, and even rails. The paper described successful experiments which had been made in the use of cast steel for these purposes. The paper concluded by stating that cast steel was now being used as a substitute for iron to a great and rapidly increasing extent. There were now, seventeen extensive Bessemer steel works in Great Britain. There were at present erected and in course of erection in England no less than sixty converting vessels, each capable of producing from three to ten tons at a single charge. When in regular operation these vessels were capable of producing fully 6,000 tons of steel weekly, or equal to fifteen times the entire production of cast steel in Great Britain before the introduction of the Bessemer process. The average selling price of this steel is at least £20 per ton below the average price at which cast steel was sold at the period mentioned. With the present means of production, therefore, a saving of no less than £6,240,000 per annum might be effected in Great Britain alone, even in the present infant state of the steel manufacture.

* From a paper read to the British Association, 1865.

VALUABLE RECIPES.*

BREWERS' PITCH.—The following compound is recommended as a good and cheap substitute for brewers' pitch:—Coat twice the inside of a barrel with a solution of one-half pound of rosin, two ounces of shellac, two pounds of turpentine, and half an ounce of yellow wax in one quart of strong alcohol. After the complete drying of the second coat, give a last coat by applying a solution of one pound of shellac in one quart of strong alcohol. This varnish will perfectly cover up the pores, and does not crack off or impart a foreign taste to the beer.

TO COLOUR STRAW BLACK.—The following is given to us as a black colour for straw hats. The quantities of material are intended for twenty-five hats or bonnets. They are kept for two hours in a boiling decoction of 4 lbs. of log wood, 1 lb of sumach, and of 5 oz. of fustic; afterwards they are dipped into a solution of nitrate of iron of 4 degrees Baume, then well rinsed with water, and when dry, are painted over with a solution of gum or dextrine. The iron liquor, as well as the other ingredients, are kept by all dealers in dye-stuffs.

A GOOD CEMENT.—An excellent cement for uniting articles of wood with metals, glass, stone, &c., may be obtained by dissolving glue in boiling water and making it of the same consistence as that of cabinet maker's glue: then add, while stirring, a sufficient quantity of wood ashes as to produce a varnish-like mixture. While hot, the surfaces to be united must be covered or coated with this glue compound, and pressed together. When cold the surfaces will be found firmly united, and much force will be needed to separate them again.

VEHICLE FOR COLOUR.—By boiling shellac and borax in water you will obtain a solution of the lac, which may be used as a varnish or as a vehicle for colours; mixed with lamp black, it has been used as an ink that will resist acids.

CHEMICAL CEMENT.—A good cement for chemical and electrical apparatus may be prepared by mixing five pounds of resin, one pound of wax, one pound of red ochre, and two ounces of plaster of paris, and melting the whole with moderate heat.—*American Chemist and Druggist.*

SCIENCE MINUTE.—Several large and influential meetings have recently been held at Belfast, Derry, Dundalk, Coleraine, and other towns in the North of Ireland, for the purpose of organising classes for drawing and science in connection with the department at Kensington. The meetings are reported as very successful.

THE PRESTON INDUSTRIAL EXHIBITION.—This exhibition was opened last week with much ceremony. The Earl of Derby was to have delivered the inaugural address, but his lordship has had an attack of gout, and could not be present. The proceedings were thus robbed of their chief attraction.

* From the *Scientific American.*

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IMPROVEMENTS IN OBTAINING HYDRAULIC MOTIVE POWER.*

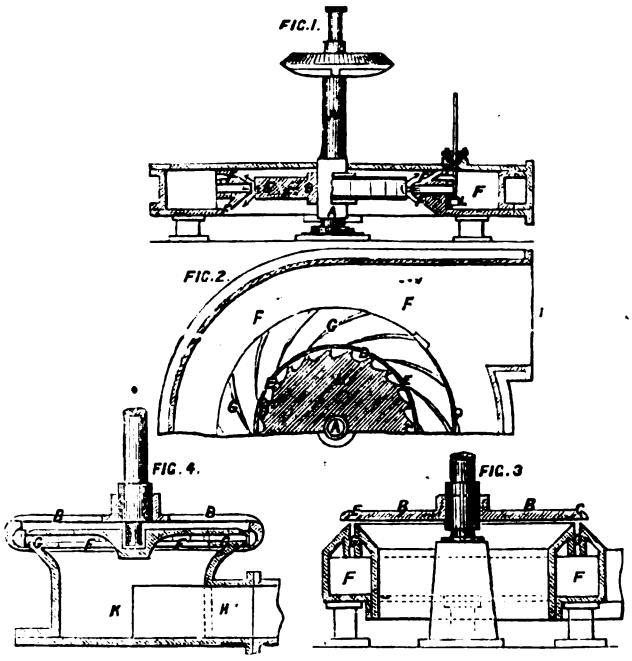
This, the invention of William Thomas Cheetham, of Ashton-under-Lyne, consists in employing a wheel with vanes thereon surrounded by an annular chamber furnished with orifices which direct the water upon the vanes, but the water after it has reached the vanes does not, as in the case of an ordinary turbine, pass onward to the centre or outward to the circumference according as the guide floats are within or without the revolving part, but returns in a direction nearly parallel to that in which it was delivered, and escapes between the annular chamber and revolving wheel.

Fig. 1 represents in vertical section one arrangement by which the principle of the invention may be carried into effect, and fig. 2 is a plan view, one half thereof being in section. *A* is a revolving shaft through which the power is to be transmitted; upon this is mounted a wheel *B*, the circumference of which is grooved out, as seen in fig. 1. The annular groove thus formed is provided with partitions *C*, constituting vanes, but these partitions are not in this instance radical lines, but are of a curved form, as seen in fig. 2, and the two views taken together show, therefore, that a series of recesses *D*, are formed with curved sides in each direction, constituting cup-formed chambers. Around the wheel *B*, is placed a water chamber *F*, the inward circumference of which has an annular chamber divided into compartments by stationary vanes *G*, similar to guide floats of ordinary turbines, and from the inward ends on each side of these guide floats the water chamber *F*, recedes at an angle, as seen at *F*, in fig. 1. The water from the source of supply enters by a pipe *H*, and fills the annular chamber *F*; and thence it passes between the guide floats *G*, which direct it to the circumference of the wheel *B*, projecting it upon the vanes *C*, formed thereon. Arriving in contact with these, it drives forward the wheel *B*, but as a reactionary force takes place, it passes along the doubly-inclined sides which constitute the vanes *C*, and escapes upward and downward between the wheel *B*, and annular casing *F*, as seen by the arrows in fig. 1,—the tapered form of the inward circumference of the chamber *F*, allowing space for its free escape.

The above description explains the peculiar feature of the invention, but it is capable of modifications, as shown in section at fig. 3. The wheel *B*, constructed as before described, is mounted over the annular chamber *F*, which delivers the water to the cup-formed vanes *C*, through the medium of the guide floats at *G*; the plan view of this arrangement would show the floats *C*, and guide floats *G*, curved precisely as in figs. 1 and 2. In fig. 4 the revolving wheel *B*, is placed on the outside of the stationary annular chamber *F*, and guide floats *G*, which receive their supply of water from a pipe *H*, leading into a chamber *K*. In order to regulate the quantity of water which shall be allowed to act upon the revolving wheel, and therefore to govern the power, the spaces between the guide floats may be partially closed by a sliding ring as is practised in turbines, or there may be a separate slide for each space or for any series of such spaces. In fig. 1 is shown the application of one slide at *L*, capable of being raised or lowered at pleasure.

The patentee claims "the use of a revolving wheel fed by an annular chamber furnished with guide floats, the former being so formed as to return the water somewhat in the direction in which it was delivered. Also the tapered form *F*, of the chamber which delivers the water to the wheel, whereby the said water is enabled to escape freely.

CHEETHAM'S MOTIVE POWER



MAGNESIAN PIPES.—Meerschaum is made on a large scale in New York, says the *Boston Advertiser*, by saturating carbonate of magnesia in silicate of soda or soluble glass—care in selecting a good quality of magnesia being the only requisite for success. The profits are immense, as will be seen. Magnesia costs about twenty-five cents per pound: silicate of soda even less. A pipe made of the "foam of the sea," as smokers verily believe, cost for material about five cents, leaving the balance for labour.

* From *Newton's Journal of Arts*

RECENT AMERICAN PATENTS.

PACKING FOR WELL TUBES.—The object of this invention is to produce a packing for oil and other deep wells which may be applied when the tube is in the well, and be removed without disturbing the tube. It consists, in general terms, of an upper and lower head, each consisting of an annular plate of metal, between which are placed annular plates or rings of leather, felt, rubber, gutta-percha, or other elastic or flexible material, which rings are connected to each other along both their inner and outer edges in alternation—the first and last of the series being also connected to the said metallic rings. By drawing out the apparatus lengthwise, the rings are drawn asunder, their faces lying in angular directions with respect to each other; and their outer and inner circumferences being drawn toward each other in proportion to the greatness of the angle made between adjacent rings. By letting the rings come together, their inner and outer circumferences resume their former positions, when they will touch the sides of the well tube and of the well respectively. P. Sicouret, of Saragossa, Spain, now at No. 152, Eighth-avenue, New York, is the inventor.

REMOVING BUILDINGS.—This is an ingenious apparatus by which dwellings and other structures may be readily moved up and down hill, or over uneven surfaces, without straining or injuring the plastering and without the trouble of levelling the track. J. S. M'Intire, No. 68, Cass-street, Chicago, Ill., is the inventor.

SHUTTER HINGE.—This invention provides a means for keeping blinds, shutters, and doors locked, when in an open position, by the movement of the hinge itself, without the necessity of using a separate and distinct device therefor; and this is effected by a very simple and durable arrangement of a small swinging bar or bolt attached to one leaf of the hinge, so arranged that when the shutter is thrown open the bar or bolt falls into a slot and between two contiguous projections upon the lower edge of each leaf of the hinge. The blind or shutter, when open, is held so securely and without any great strain upon the hinge that no ordinary gale of wind can injure it, and, at the same time, the attachment is so simple, and the movement so easy, that a child can close the blind or shutter without any perceptible effort. Its durability and simplicity of action, combined with the fact that it can be made at a mere trifling additional cost above the present price of shutter hinges, recommend it to the consideration of manufacturers. Samuel R. Dummer, of No. 137, Broadway, New York, is the inventor.

ROSE ENGINE.—This invention relates to certain improvements in rose engines intended for cutting glass, and it consists in the use of a parallelogram, the sides of which are hinged together, in combination with a box calculated to hold a fork or other equivalent device that forms the bearing for the shaft of the revolving tool, in such a manner that said tool can be readily held up to or taken off from the work without danger of causing jerks or jars which would have a tendency to break or injure the work. The invention consists, further, in the application of a hinged tool-holder, in combination with a carriage or slide moving back and forward in a suitable rest, in such a manner that by means of the rest the tooth can be adjusted to any desired position in the usual manner, and by the hinged holder can be brought up to or removed from the surface of the work with the greatest ease and facility, and without danger of spoiling the work. It consists, finally, in securing the shaft of the revolving tool in a forked or other bracket, which is connected to the rest or supports by a set screw or other suitable means, in such a manner that said tool can be readily turned in either direction or detached from the supporter and replaced by another of the same or of different shape. Anton Schwitter, No. 177, Broadway, New York, is the inventor.

SORGHUM EVAPORATOR.—This invention relates to a new and improved pan for evaporating sugar, designed chiefly for evaporating sorghum, and it consists in the employment or use of movable partitions, with an open end pan, and also a side chimney for the furnace, whereby a superior article of syrup is obtained, and the evaporating process rendered continuous it not being necessary to stop in order to cleanse the pan and remove the latter from the furnace, as is now required. Joel Kindley, Oskaloosa, Iowa, is the inventor.

A FRENCHMAN ON WATER POWER.

An ingenious Frenchman, one M. Cazal, has hit upon a plan by which to utilize the force of falling water, not only upon the spot, but at great distances. This gentleman proposes to convert the mechanical force of falling water into electricity. For this purpose he has simply to make the water act upon the wheel-work—just as in the case of a water-mill, only instead of turning the stones which grind the corn the mechanism will act upon a magneto-electric apparatus. The electricity thus developed will then be conveyed to any required distance by means of insulated wires. Just as an operator in London can ring a bell at York, or fire a cannon at Edinburgh, or make a ball descend at Portsmouth, so M. Cazal can transmit the force of a cascade from the mountains of Switzerland to the workshops of Paris. Arrived at its destination, the electric force has simply to be re-converted into its mechanical state, and it does the work as nearly as if the falling water were itself brought to the scene of operation. That at least is the theory, and the theory is true; we believe it has already been tested, and the French manufacturers are about to try it on a still larger scale than before, though we do not mean to say that M. Cazal has yet gone so far as from Paris to the Alps in search of his power. It is a strange idea, that of seeking in the flood what we have hitherto found in the fire—relying, in fact, on cold water instead of steam. The economy of the process is said to be quite as remarkable as its physical character. M. Cazal, in some sort, finds his power already provided; he merely has to pack it up in a convenient form for travelling, and then to unpack it at the journey's end. At this rate we only want a submarine wire of sufficient capacity, and England might draw its motive power from the mountainous regions of the Continent—the Manchester spindles rotating in virtue of a foreign influence. Or, to stretch the point still further, let us imagine the Atlantic telegraph an accomplished fact, we have then only to send M. Cazal off with a wire to the Horseshoe Falls, and all the force of Niagara itself will be at our command.—*Morning Paper.*

WATER heated in a strong closed vessel has melted lead at 612 deg.

SEA water is both salt and bitter at the surface, but only salt in its depth.

READING INDUSTRIAL EXHIBITION.—The exhibition of industrial productions and valuable works of art lent by her Majesty and the principal gentry of Berkshire, is now open daily at the Town Hall, Reading, and is attracting a constant stream of visitors.

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ON ALLOYS

Every thoughtful metal worker, who has his hands too full of his daily employment to spend much time in experimenting on the properties of the metals he uses, must have often wondered how it came to pass that, with all our boasted knowledge of chemical and metallurgical subjects, we have as yet only succeeded in inventing some half-dozen useful alloys. Brass, pewter, gun-metal, German silver, and type metal are really all the alloys that we can name as entering into the manufacture of the more common articles of trade in this country. The causes of this apathy in experimenting on the properties of mixed metals are manifold. The practical metal worker of the present day is generally ignorant of the chemistry of the metals he uses; and, even if he were well informed, he would be too busy fighting the great battle of competition to set himself the extra task of experimenting upon alloys. But metal workers will turn round, very naturally, and ask how it is that practical chemists, whose business is to make experiments, do not investigate the capabilities of metallic mixtures more frequently than is at present the case? We fear very much that the only answer to be given to this is that scientific chemists of all countries have, almost without exception, been bitten with the mania for nearly exclusively pursuing their researches and expending their talents upon organic compound. This department of scientific chemistry is so vast and so fruitful in results, that it is quite a rarity to see an article in a scientific journal upon a metal or metallic compounds. Even those chemists who have not wholly given up the study of inorganic compounds seem to apply themselves to analytical observations, or to the investigation of the rarer metals. As an example of the want of knowledge of the capabilities of alloys, we may instance the discovery lately made by M. Pelouze, of the French Mint, that the best metal with which to alloy silver is zinc, and not copper, as we have always believed. Now, considering that silver has been known from the remotest ages, and zinc, at any rate, since the birth of modern chemistry, it seems singularly strange that no one ever thought of trying the effects of these two metals on one another until now. To take the case of iron, a merely cursory examination of the second volume of "Percy's Metallurgy" will show that some of the very simplest questions relating to this most common and important metal remain as yet unanswered. Such an apparently vital matter as the formation of steel is a bone of contention at nearly every meeting of the French Academy of Sciences,—one party persisting in declaring that no steel can be made without the intervention of both nitrogen and carbon, while the other side as manfully contend that nitrogen has nothing to do with cementation, carbon being the only element concerned in the process. This example shows that not only does the action of one metal upon another, in a state of combination, require patient study, but also that the effect of the addition of varying proportions of the metalloids, such as carbon, phosphorus, silicon, sulphur, &c., to different metals, is still undiscovered.—*Chemist and Druggist.*

EYE PROTECTORS.

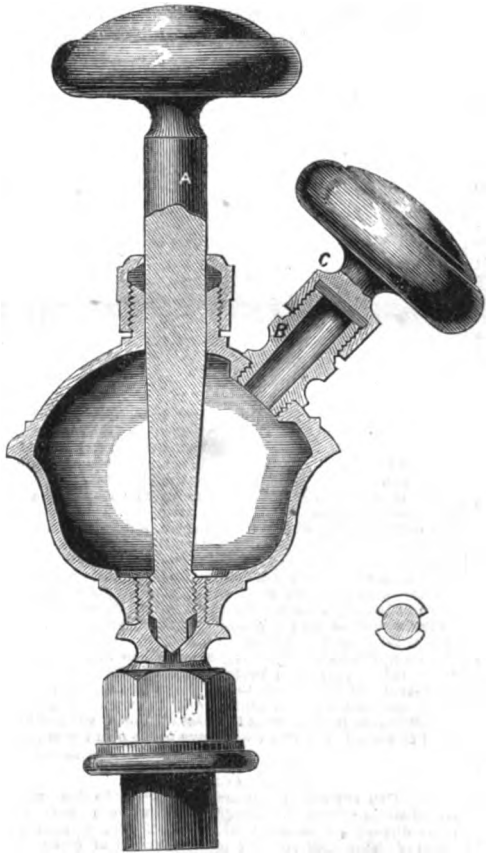
Mr. Henry Vale, of Birmingham, optician, has patented certain improvements in the manufacture of eye protectors—in making the frames and in attaching them to the wire gauze. In making these frames according to the new method the patentee proceeds somewhat as follows:—There is cut out from sheet metal at a press ring: like blanks of a nearly elliptical figure, the said blanks having at opposite points nearly circular pieces to form the loops in the finished frame. By means of raising tools and pressure, these blanks are raised into a trough-like form, and at the same time are raised and perfected the shape of the loops at the end of the frame. There is thus produced a trough-like frame provided with the necessary loops, the sides of the said trough being nearly parallel. Instead of raising the frame from metal rings a raised blank may be formed from sheet metal, the metal inside of, and external to, the depression in the said blank being afterwards removed by cutting dies or tools. In securing the wire gauze of the protector to the frame the edge of the gauze is placed in the trough of the frame, the sides of which are then closed upon the gauze, and the gauze firmly secured to the frame. By raising the frame from sheet metal, a neat frame without a junction is produced, which is attached to the gauze without solder.

BROUGHTON'S GRADUATING LUBRICATOR FOR STEAM ENGINES.

It is important that the valves and cylinders of steam engines should be oiled occasionally, since the friction is not only lessened thereby at the time, but the expense of repair is much reduced. The lubricating faucet here shown is one of the simplest we have ever seen, and is constructed in the best manner and of the most serviceable material. The combination of mahogany and brass give it a neat appearance also, so that it is ornamental to any steam engine. Its parts are few and simple, and a total absence of cocks and valves opening externally, which always wear and become leaky, is its most distinguishing feature, as will be seen by reference to the engraving.

It consists of a reservoir, with a stuffing box at top and a solid central stem, A, passing through the top of the reservoir, and screwing by a thread on its lower end directly into the shank, where it forms an internal valve in connection with a seat in the shank. There is also an auxiliary opening, B, for filling, which is closed by a tubular cap, C.

The central valve, when screwed down, cuts off the communication with the steam chest. The first rotation of the tubular cap, when taking it off to fill, will allow the steam in the reservoir to blow out, in a direction away from the hand of the operator; the



oil can then be poured in, and the air will freely escape. The tubular cap has a composition seat, and forms a durable and perfectly tight joint. When the reservoir has been filled, and the cap replaced, the oil may be graduated to feed fast or slow, as required, by unscrewing the central stem, A, from a sixteenth to a quarter of a turn; or it may be fed at intervals by unscrewing for a few seconds, and then closing it again. The reservoir cannot be filled without leaving a small space, or air chamber, above the oil; into this the steam will rush when the valve is slacked, and the pressure will be equalized, and the oil pass out.

The formation of the stem is shown in the small figure; the grooves admit the oil when the valve is opened.

The central stem may be withdrawn at any time, without disturbing the packing in the stuffing-box, and the shank can be unscrewed from the reservoir. The handles are of wood, and being non-conductors of heat, can be operated without using rags or cotton waste.

This simple arrangement forms a perfect lubricator, serving every purpose and performing every function required in lubricating valves and cylinders. Its advantages are: It will not leak, consequently it is clean, and wastes no oil; it will shut off the steam from the steam chest by an internal valve, not liable to wear; it will blow the steam out of the reservoir without the possibility of scalding the operator; the oil can be poured in without any open cup to catch dust and dirt, and the air can freely escape without the use of pet cock, or air passage: the oil may be all fed to the cylinder in one minute, or it may be graduated to last a whole day.

Manufactured by Broughton and Oakman, No. 41, Centre-street, New York, U.S., America.

ON THE APPLICATION OF SPECTRUM ANALYSIS TO MICROSCOPICAL INVESTIGATIONS.*

By H. C. SORBY, F.R.S.

(*Continued from page* 308.)

It appears that in various conditions blood yields no less than eight very different spectra. At all events, we can most readily get four or five, so characteristic, that with proper care there could be no fear of confounding it with any other substance that I have hitherto examined, and probably not with any in existence. However, in all important investigations, it would be advisable to examine the spectra of any substance likely to be present. I would also specially insist on the importance of carefully attending to the exact position and character of the absorption-bands; and before anyone gave evidence on such a subject, that he should make himself practically familiar with the facts I have described.

In applying this method to the detection of blood-stains on various articles of clothing, it is requisite to ascertain the effect of the different materials, dyes, and mordants. I have for this purpose made a great many experiments, and yet probably much remains to be learned. As a general rule, the dyes exercise little or no prejudicial influence; but when alum has been used as a mordant, it produces an effect which might easily mislead. Hitherto I have not been able to overcome the effect of the tanning in different sorts of leather. They precipitate the colouring matter of the blood, and no spectra can be obtained. If, indeed, the blood can be scraped off from the surface without any considerable amount of leather, it can be detected as usual; but, if it had been sponged or washed, probably no trace whatever could be detected. The same applies in the case of those woods, which, like oak, contain tannic acid. Vegetable soil, when its amount is large in proportion to that of the blood, also precipitates the colouring-matter in an insoluble form; but, where the relative amount is small, as on dirty clothes, it does not sensibly interfere with the test, though it tends to impair its delicacy.

When scarlet or brown cruorine is acted on by a solution of alum, it is converted into hæmatin. If it has been used as a mordant, sometimes a portion remains in such a condition as to produce this change in blood stains; and, moreover, the alumina may combine with the colouring-matter of the blood, and make it insoluble. In such cases it is impossible to obtain the spectrum of either scarlet or brown cruorine; but if a piece of cloth, mordanted in this manner, marked with blood, be digested in a few drops of water in a watch glass, and repeatedly squeezed with forceps, a turbid solution is obtained, which, treated with citric acid, filtered, rendered alkaline with ammonia, and deoxidized with protosulphate of iron, shows quite well the spectrum of peroxidized hæmatin No. 8.

In a few cases the colouring-matter of the dye is slightly dissolved by water. I have especially noticed this in the case of black printed calico; and if much of such material, containing very little blood, be digested in water, the dye may cut off the characteristic part of the spectrum. Care should therefore be taken not to use any of the material not well marked with blood, and to have the solution so dilute that the dye may not cut off the green rays.

Almost everyone must have noticed the fact that, when a bloodstain on white linen or calico has been exposed to pure air for only a short time, it can be almost entirely dissolved out by water; but, if dried and exposed for some time, the imperfectly soluble brown cruorine cannot be entirely removed, and leaves a brown stain, which, though readily seen on white material, might be scarcely visible on coloured or black. However, on digesting the suspected portion in a few drops of water with citric acid in a watch-glass, and proceeding as already described, a

* Extracted from the *Quarterly Journal of Science.*

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most unmistakable spectrum like No. 8 may be obtained, even when the stain is only half-an-inch square, and scarcely visible. In attempting to remove a blood-stain from cloth by sponging, on the first application of the water a solution of blood would be formed, and run into the surrounding cloth by capillary attraction. Hence, though the stain may appear to have been removed, the cloth round about might, and probably would, retain abundance of the colouring matter, which could be dissolved out. Any suspicious marks that might be due to such treatment should therefore be examined with care. Of course, in such cases the microscope alone would be of no avail, and mere chemical tests could not be relied on, and thus the spectrum method becomes especially useful. Specimens of this character having been placed in the hands of some of the first authorities in such inquiries, they said that neither they nor anyone else could make out anything from them; nor would they believe that I could, though the amount of blood was such that in a few minutes I could have shown such a spectrum as No. 8, and have been in a position to give evidence with great confidence.

When soap is present it causes a precipitate; but this is quite soluble in plenty of ammonia, and does not prevent our seeing the spectrum No. 8. Boiling water, instead of facilitating the removal of blood, makes it more fixed, by coagulating the albumen. If the blood be dried on glass, the colour is changed to a brownish red, and it gives a spectrum like No. 5, whether dry or damp. When dissolved by citric acid, it yields hæmatin, and readily gives spectrum No. 8.

In some cases foreign matters, or the mordants, make the solution so turbid that it is difficult to see the spectrum to advantage. If we wish to observe the spectrum of blood in its natural state, or as it becomes by mere exposure to the atmosphere, it is better not to filter, but to allow the solution to stand in the cell in front of the slit, until it has become sufficiently clear; because filtering would probably remove much of the colouring-matter of the blood. However, in some varieties of brown cloth the mordants give rise to such a turbid solution, that it is very difficult to see the spectrum in a satisfactory manner. Citric acid should therefore be added to make the colouring-matter more completely soluble, and the liquid filtered. For such small quantities a blotting-paper filter ¾ of an inch in diameter should be used. It can be conveniently supported on a platinum wire bent at one end into a ring, and made to slide up and down a small wire for a support; and if the bottom of the filter touch the cell or watch-glass, though the liquid may pass through slowly, the final result is far more satisfactory. After the acid solution has passed, it is well to add the ammonia by allowing it also to go through the filter, to carry away any colouring-matter, soluble in that reagent, that might remain on the filter.

(To be continued.)

OUR SUBSCRIBERS' NOTES AND QUERIES.

IRON.—What is meant by hydrot pig-iron?—the difference between that and pig-iron? What is burnt iron? what is taken away and what added to it?—WELLINGTON.

VENETIAN BLIND PAINT.—Of what is it made, and how used?—WALSALL.

GALVANOMETER.—How to make a vertical one for ascertaining power of electric current?—A LOVER OF SCIENCE.

CONTACT BREAKER.—How is it made, and how does it work? Where can I learn of the one used for the large coil in the '62 Exhibition?—J. ROUND.

TO MAGNETISE BARS.—How best to strongly magnetise two round bars, about 3 inches long, ¾ inches diameter? (I have horse-shoe magnets and electrical apparatus—don't know how to use them); also, best book on subject?—COMUS.

INDUCTION COIL.—In construction, is it necessary to insulate from each other the wires composing the iron core?—T. B. R.

STEEL POLISH.—How obtained, as on flat steel pieces in fine watch work?—JOHN COWAN.

PAINTING ON GLASS.—How to paint on glass, such as writing on the back in shop-fronts, and making it transparent? I appeal to British workmen.—AN ENGLISH DECORATOR.

BUILDING CONSTRUCTION.—Where to obtain the book used at South Kensington, and one on "Solid Geometry"—sections, traces, pyramids, prisms, &c.; also one on "Perspective," with price of each.—GEOMETRICIAN.

SOLDER.—In repairing brass, how can I give the solder the permanent colour of brass?—DRILL.

POLISHING CASTINGS.—The best way of polishing iron and brass castings, and malleable forgings—sizes of emery requisite, manner of covering the same, and requisite speed for polishing?—A JOHNSTONIAN.

TEST FOR COIN.—Wanted, a good test for bad silver.—JAS. WARD.

ZOPISSA PAPER.—Is Zopissa paper sold in bulk, or only the articles made from it? Where is it sold?—A. M.

PEROXIDE OF BARIUM.—The price of it, where it may be had, or how to prepare it?—CHEMICUS (Derby).

BLUEING SPRINGS.—How to do this without altering the temper, cheaply?—A. SMITH.

POLARISCOPE.—The use of it—what objects look well in it; the difference between that of J. Sargent and C. T. Whitmell: also descriptive dimensions of part of Camera Lucida.—Q. C.

LAPIDARY.—How to cut and polish stones and agates?—DRANEEB.

Sir,—Can any of your readers inform me how to bore small brass cylinders? An answer will greatly oblige

J. H. J.

ASTRONOMICAL GLASSES.

Sir,—Can any of your readers inform me how to produce glasses for astronomical instruments in a raw and finished state? Or if any work is published on this subject? SWEDE.

GALVANIC BATTERY.

Sir,—Can any of your readers inform me of the cheapest and most durable galvanic battery that, with a condenser, would give ½ inch spark? The name and agent will do.

H. BROWN.

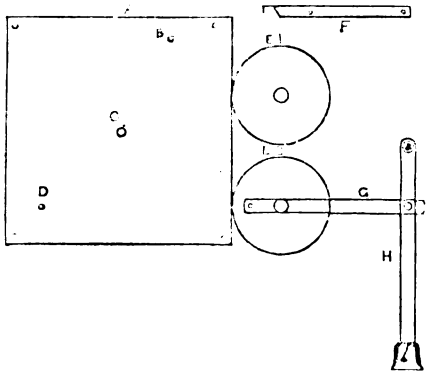
[Thanks for sketch—W. Joyce will find two or three machines illustrated in back numbers.]

CYLINDER NOZZLE.

Sir,—Would any of your correspondents please to inform me what would be the correct size of the passages for the nozzles of a 3 inch cylinder and the proper thickness of the metal for the cylinder and nozzles that size; and if there is a general rule by which we may calculate from that an extension of sizes. MODELLER.

ALARUM.

Sir,—In answer to Charles Waterhouse I send a rough illustration of an alarum. A, A is a piece of thin charcoal iron



plate, 4½ in square; B, C, D, are three ¼ in. studs rivetted in plate; B, 2½ in. long; C, 1½ long; D, 2½ long; E, E, are the two flanges of a thing in shape of a common cotton reel, made to revolve on stud D, 2½ diameter; H is a piece of same iron, 7½ long, with bell riveted to end, and made to work on stud B; G is a connecting link made to work on a small crank pin riveted in flange E 2, to impart eccentric motion; F is a catch 4¾ long with hole off centre, slipped on to stud C—this completes the affair. Let C. W. fasten this on the wall above his clock, get a piece of twine the length of the wall, tie a weight to the end of it, wind it round the wheel, put the catch in notch of flange E1, attach a piece of twine to end of catch, wind up his clock to top, tie catch twine to the weight of his clock, and calculate how many hours it will take for the weight of clock to lift catch; for example, if the weight of clock takes an hour to come down three inches, your catch twine will require to be 21 inches long from bottom of clock to lift the catch in 7 hours. If C. W. has not a common chain clock, he can make a pair of wooden scales and bring the alarum down with either sand or water. The rest I will leave to his own ingenuity.

EDINA.

RESUSCITATION.

Sir,—Can any reader tell me the best way to deal with an old steam engine, grasshopper class, made in 1836. Of these dimensions:—Stroke of piston, 2 feet 6 inches; speed of piston, 250 feet per minute; travel of valve, 3¼ inches; lap of valve, 7-16 inches; lead, 0. Admission over 90 per cent. and without governors, and suffering from condensation. I have tried the valves more lately at 2 in. and 1-16 travel, and 75 per cent. admission with 1-16 in. lead; and I find the engine runs a considerable deal better than before as regards steadiness and fuel. But I was obliged to take the lead from the valves, as she heated and knocked the crank shaft journal so greatly. If I have new valves what is the most useful lap and travel; and the greatest useful admission per cent. of stroke. A plain and practical answer through THE ENGLISH MECHANIC will greatly oblige E. WATSON, Engine Driver.

HAND FLY-WHEEL.

Sir,—I would advise your readers who can, to go to and look into the Agricultural Hall at a hand fly-wheel which has been sent in, and stands near the Liverpool-road entrance. It is as near a perpetual motion as anything I ever saw.

G. KIRKWOODE.

CHUCKS.

Sir,—I am surprised Mr. Cotchett should send a chuck so much like mine (published in your 23rd number). I believe my chuck to be simpler, and stronger, therefore better; and believing it to be original, I venture to encroach thus much on your space. THOMAS E. MERRITT.

PISTON VELOCITY.

Sir,—I am desirous of ascertaining at what velocity a piston will move, supposing the cylinder to be increased to double its length and the area of the piston to be only one half, whilst the pressure of steam remains the same, and the valves remain the same; for instance, supposing the pressure to be 30lb., and the cylinder 60 in. long by 8 in. wide, instead of 30 inches long by 16 in. wide. My question is, ought not the piston to move at nearly double the velocity, and if not, why does it not do so?

J. T. MILLINGTON.

PRINTER'S INK.

Sir,—In answer to "New Leeds" in No. 25 of THE ENGLISH MECHANIC, the following is one method of making printer's ink:—Put linseed oil into an iron pot capable of holding two or three times the quantity introduced, heat it over a fire until a dense vapour arises from it; then, having removed the pot from the fire, apply a lighted match, attached to the end of a stick, to the surface of the oil, when the vapour will inflame; allow it to burn, until on taking out a small quantity of the oil, it is found to be thick and tenacious; the flame is then to be extinguished by putting a cover over the pot. To six quarts of oil, thus prepared, add gradually 6 pounds of black resin, and dissolve it by the aid of heat, then add, in small quantities at a time, 1¾lb. dry yellow soap, cut into slices, and effect the combination by stirring and the application of heat; this is the varnish of which the ink is to be made, and on the careful preparation of which the quality of the ink much depends; this is to be mixed with 2½ ounces of ground indigo, the same quantity of ground Prussian blue, 4lbs mineral lamp-black, and 3½lbs. of the best vegetable lamp-black, and the whole ground together into a perfectly smooth and uniform paste.

Ink of different colours are made by mixing the varnish with various pigments, such as vermilion, red lead, Indian red, chrome yellow, chrome red, verdigris, Prussian blue &c. &c. JAMES WARD.

PRESSURE.

Sir,—In reply to "J. Soundle" He asks what pressure per inch he should have in the boiler if a vertical column is suspended in an inch tube 24 feet from top of boiler.

Steam or any fluid that as pressure exerts its force according to the height of the column of water above the sectional area makes no difference. Thus, a column of water suspended 34 feet above the boiler will produce a pressure 15 lbs. per square inch.

The following, I think, will do for a rule:—

$$\frac{15 \times 24}{34} = 10{\cdot}588 \text{ lbs.}$$

According to rule, the pressure for a 24 feet column will be 10·588 lbs. per square inch.

It makes no diference as to diameter of tube, because the pressure of steam counterbalances every square inch of the area at the base of column. J. NEWTON.

Sir,—In reply to J. Soundle's query in No 25 of THE MECHANIC, as to the pressure in his boiler, I beg to inform him that the weight of water contained in a pipe 1 in. diameter, and 12 in. long, is equal to 341lb., and $24 \times .341 = 8.184$ lbs., the pressure in his boiler.

X. Y. Z.

TO HARDEN COFFEE MILLS.

Sir,—In answer to "Arthur Stillman," of August 11. The way to harden cast-iron coffee mills is to get to blood-red heat, and then potash, finely-powdered, sprinkled on till it is melted, and then slacked in cold water.

I have used the above, which answered very well for years. A. SMITH.

BATTERIES, &c.

Sir,—I beg to answer the following:—E. M., No. 24, Amalgam. Dissolve sealing-wax in wood naphtha, and apply with a brush. If you go over the same place more than once, do it quickly, as the evaporation is rapid.

E. M. No. 25—Induction coil.—Gutta Percha covered wire will do, but is not so desirable as cotton, as the insulation is thick, and increases the distance between the wire and core; thus diminishing the power. A condenser is, I believe, for the purpose of collecting the electricity which would otherwise escape at the points of contact, *i. e.*, the make and break, and discharging it by induction into the secondary wire. Also for preventing, as it were, a Leyden jar forming between the primary and secondary coils, which would tend to spoil the machine.

F. Harwood.—No. 25.—At almost any wire drawer's, or optician's. Ladd, 11 and 12, Beak-street, can supply, no doubt, No. 35 I think. The length to be found is 1,405 yards.

Alfred Cross.—No. 25,—Certainly, and the best way too. A couple constructed on this principle will last 4 months without refreshing, if it be well and properly charged at starting. The cells as described ought to have lasted 2 months at the least. The pots must have been bad—too porous.—Try again, and succeed.

Cells, Coils, &c. &c.—No. 25—William Tonkes deserves knighthood, and nothing less.

I propose to make an induction coil of the following dimensions:—Core, 12 in. between discs, 1¼ diameter. No. 16 annealed iron; primary, 4 convolutions No. 12, 7 strand copper, (cotton). Secondary coil, 6,000 yards. No. 35, silk covered copper wire Will you or your correspondents kindly inform me whether the dimensions and materials given, are of the order to ensure success, and what results I may anticipate?

I do not remember any mention having been made of the size and number of sheets used by Rhumkorff in his condenser. Will 24 or less 11 by 6 in. suffice for my coil?

I propose to work this instrument—when made—with 6 elements "Smee" 2 in. by 3½ in.; will this be too much or too little power? AMATEUR.

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Sir,—I have taken the liberty to send directions to enable anybody to make an electrical machine, that will show all the rudiments of electricity for, at most, 2s. :—Get a disc of tin ten inches in diameter, and have the edge turned up about half an inch all round. Fill it with the following mixture :—

Melt one pound of resin, when melted, add one or two spoonfulls of olive oil, and let it harden. Meanwhile, make a disc of wood 6 or 7 inches in diameter, and cover it with tinfoil ; also fix a glass rod in the back to serve as an handle. With a nice dry piece of flannel your apparatus is complete. To use it, warm the flannel, and rub it briskly on the resinous plate; then touch the resin with the tinfoil, and so on. H. BROWN.

Sir,—In reply to "Mr. Crofts," all the red porous cells I have tried (and some of the thin white ones). Allow the oxide of copper to form on the zincs. It would be better, therefore, to charge the cells with silver sand moistened with acidulated water ; this will tend to prevent it, and increase the constancy of this battery. J. ROUND.

ADDRESS ASKED FOR.—Chas. Collins, Microscope Manufacturer, 77, Great Titchfield-street, Oxford-street, W., and at the Polytechnic Institution.

WYLLIE'S PORTABLE STEAM RIVETTER.

The rivetter belongs to the steam-hammer class, and performs the rivetting by a succession of blows. The rivetter is made with a swage tool always, whether for flush rivetting or for snap heads; and this swage tool is held in the front end of the cylinder, and forms a loose plug or plunger not connected with the piston, while the piston itself is an independent bolt or hammer of suitable weight, traversing backwards and forwards like a shuttle in the cylinder, and striking the end of the swage tool within the cylinder. By this arrangement the swage tool or tool-head remains almost stationary, and the length of the machine is reduced to only the length of the stroke of the piston, together with the struck part of the tool-head, the length of the piston, and the thickness of the back cover, and the length required for the stroke outside the cylinder, and for the shuffling box are got rid of altogether. This is not only a saving of length, but also an economic simplification, and does away with the risk of breaking the bottom of the cylinder by an unobstructed stroke of the hammer, since the tool-head, being entirely loose in the cylinder, act as a safety bottom to the cylinder. In rivetting, the tool-head simply follows the rivet, as it is hammered up and remains in contact with it, so that the workman has to look at an almost stationary tool-head instead of at a rapidly moving hammer, and he can, therefore, better adjust the position of the machine to the proper formation of the rivet head. The machine is of such a size that the workman can hold it in its position independent of its mechanical fixings, .With steam at sixty pounds pressure per square inch, it is found sufficient to make firm work with 1¼-inch rivets. The machine weighs thirty-six pounds, and is perfectly portable. It is Mr. M'Farland Gray's patent. At straightforward work, such as the side of the Britannia Tube, it will fix fifteen hundred 1-inch rivets in a day of ten hours, and does not require skilled labour. Two men work the machine, and are supplied with rivets by rivet lads in the usual way.

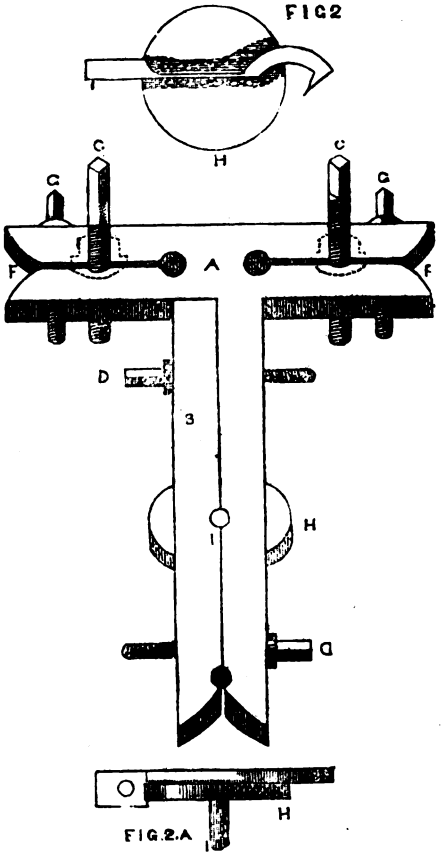
THE ORIGIN OF PHOTOGRAPHY.

The Rev. J. B. Reade has called attention to the fact that Baron Liebig, in stating that Mr. Talbot arrived at the use of gallic acid by induction, makes an error. Mr. Reade, who was the first to use gallic acid, had really informed Mr. Talbot of its properties in accelerating and giving intensity to the photographic image. Mr. Reade had produced photographs with the aid of gallate of silver years before Mr. Talbot. It was, moreover, when taking an impression direct from the *Trientalis Europæa*, and not when using the solar microscope, that Mr. Reade, being called away, afterwards found a perfect impression on paper which had been thrown away, containing no image. Mr. Reade remarks that, singularly enough, even then the notion of the existence of a latent image did not enter into his mind. The recognition of the idea of a latent image capable of development Mr. Reade considers due to Mr. Talbot. It must not be forgotten, however, that the existence of a latent image and a process of development had first been discovered by Daguerre. We note these corrections by Mr. Reade with pleasure in the interest of historic truth. In a few years there will be no living witnesses to give their testimony on these points.

THE Union Copper Mine, at Copperopolis, during the month of June, shipped from the mine to San Francisco, *via* Stockton, the large amount of three thousand six hundred tons of ore, the freight money on which was 29,000 dols.

IMPROVED T POLISHER.

This tool, which is indispensable in polishing a job (underhand) perfectly flat, is perhaps unknown to some of those readers of THE MECHANIC who are engaged in the horological art. I have no doubt, therefore, that the accompanying drawings and description of a T, or underhand polisher, will be found very useful. The drawings are twice the actual size of the tool. It is made of brass, and mainly consists of two pieces, the stock, or T (hence its name), A, and the clamp piece B. My improvements are, 1st, the securing of the elevating or surface screws from shifting when in use. 2nd, applying an independent piece for attaching with shellac or wax, jobs which are too delicate to be held in the clamp piece. The elevating screws C, C are used for adjusting the tool to the level of the job to be polished, while the screws D, D are for securing the job between the clamp piece and the polisher. The usual method of securing the elevating screws when set is by pinching nuts, as shewn by the



dotted lines at E, E ; but in a short time these get too free or loose upon the screws; the result of which very often being that having got your job perfectly flat, and a beautiful polish coming up, you discover that one of the screws has made a shift which compels you to flatten your job over again, To prevent this, I have run a saw draught, F, F, down the top of the polisher, and put in two pinching screws, G, G, the slightest turn of which effectively secures the elevating screws, so that there is no possibility of their shifting when the tool is in use. In order to polish anything delicate, it has (as before mentioned) to be secured to the tool with sealing wax or shellac. For this purpose I have a brass disc, H, which is held in the polisher by the stud I ; it is easily removed for the purpose of heating, thus obviating the necessity for heating the whole tool, as is usually done. Figs 2 and 2 A shew the disc with a Geneva rotchet click fixed in position for polishing. JOHN MCKAY.

THE resistance of the air to a cannon ball of 2 lb. weight, with a velocity of 2,000ft. per second, is more than sixty times the weight of the ball.

VEGETABLE ivory may be coloured almost any shade of purple by the more or less prolonged action of concentrated sulphuric acid.

SILVER can be beaten into plates of which 110,000 make an inch, and drawn into wire of the 13th of an inch, sustaining 137 lb.

SCIENTIFIC DODGES.

It is well known that ink is a precipitate of gallate of iron mixed up and kept in suspension in gum and water. As the water evaporates the ink thickens, and, moreover, becomes mouldy owing to a small proportion of organic matter proceeding from the gall-nut. M. Mathieu Plessy has got rid of these inconveniences, by making a new kind of ink with pyrogalic acid and the colouring matter derived from Brazil wood and other sorts of wood used in dyeing. This ink flows well, and never turns yellow on paper. Dr. Werner, physician to the factory of MM. Dollfas at Mulhausen, treats wounds and sores of every kind with a liniment thus composed :—Strasburg turpentine, 1,000 grammes ; bicarbonate of soda, 25 grammes ; distilled water, 10 litres. Digest for six days in a water-bath at a temperature not exceeding 75° centigrade, and filter. This is a sort of turpentine soap, much more soluble in water than turpentine itself. It evaporates but slowly and costs very little. Most wounds are cured in one-third of the time required by other applications. In some cases the wound heals with extraordinary rapidity, but in all its appearance is healthy, and very little suppuration takes place—a very important circumstance, since it prevents the danger arising from purulent infection. Radishes may be grown in a very few days by the following method :—Let some good radish seed soak in water for twenty-four hours, then put them in a bag and expose it to the sun. In the course of the day germination will commence. The seed must then be sown in a well manured hot-bed, and watered from time to time with lukewarm water. By this treatment the radishes will in a very short time acquire a sufficient bulk, and be good to eat. If it be required to get good radishes in winter during the severe cold an old cask should be sawn into two, and one half of it filled with good earth. The radish seed, beginning to shoot as before, must be then sown in, the other half of the barrel put on the top of the full one, and the whole apparatus carried down into the cellar. For watering lukewarm water should be used as before. In the course of five or six days the radishes will be fit to eat.—*Galignani's Messenger.*

THE magnesium light is found to be sufficiently active to determine the combination of hydrogen and chlorine.

A CUBIC inch of mercury at 63·30 deg. weighs 3425·35 grains.

PATENT LIST.

(*From the Commissioners of Patents' Journal.*)

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HEWITT'S PATENT COMPOSITION, for the REMOVAL and PREVENTION of INCRUSTATION in STEAM BOILERS.

In submitting to the public, William Hewitt's Patent Composition Preventive of the incrustation in boilers, the inventor begs to direct attention to the peculiar merits of his discovery, consisting of ANIMAL MATTER free from injurious acids and volatile ingredients. Being, for the most part, mechanical in its action, it covers the boiler and tube surface with an unctuous coating which detaches, where formed, or prevents the adhesion of saline or other deposits on the boiler surface.

The composition is manufactured in a block, or solid form, which is inserted (through the man-hole) in the boiler, when its properties are progressively developed, and generally diffused by heat, as the substance is slowly dissolved:

Although the guage-pipe will show the water to be slightly discoloured, it is nevertheless wholly innoxious, indeed in some parts of the West of England where the composition is used, the water is applied to many domestic purposes, and also for dressing the food for the cattle employed in the manufactories and farms.

The inventor is justified in asserting, from the experience of trials, (extending over two years) and inquiries made up to date, that the unctuous and other properties of the composition, do not cause but prevent priming, and not only tend to preserve the boiler from incrustation, (which occasions great loss of heat and often causes the crown of the furnaces to be burned) but will also remove incrustation, however aggravated.

Its advantages over the LIQUID compositions are so obvious as scarcely to require comment, though it may not be inexpedient to observe that the difficulties and restrictions attending these in respect to "blowing off," etc., are entirely obviated in this invention.

Danger from contact with the valves in the boiler, need not be apprehended, as the specific gravity of the composition is so great, that it is only slightly moved on the bottom of the boiler by the ebullition of the water.

The inventor trusts that the novel and favourable character of the composition as displayed in its immunity from any injurious qualities, or volatile ingredients, simplicity in application, and lengthened time during which it will continue to yield beneficial effects without renewal, may ensure it a fair trial, when it will be found to have done its duty well and effectually.

It is confidently believed that in a little time hence, when its efficacy and safety are more widely known, that it must become the Composition of universal consumption.

The cash price is fixed at 42s. per cwt., equivalent to THREE FARTHINGS PER HORSE POWER, PER WEEK; an infinitesimal figure, as compared with the increased consumption of fuel occasioned by an incrusted Boiler, loss of effective power, and proportionate injury to Boilers and furnaces.

All communications, to be addressed to—

JAMES HARRIS,
Manager and Principal Agent for the Inventor and Manufacturer,
Temporary Office—
9, CAMBRIDGE STREET, PIMLICO, LONDON, S.W.
September 1865.

DIRECTIONS FOR USE.

Cut, or saw, off as many pounds of Composition as thereare nominal horse power of Engine, and put it in the Boiler through the man-hole; this will be a sufficient quantity for six weeks' duration. Where Boilers are opened once in two months only, it will be necessary to add one-third more in weight of the Composition, and so on in proportion, for example:—

A 30-H.P. Boiler cleaned every six weeks requires 30 lbs.
" " two months " 40 lbs.

In all cases where a Boiler is dirty, it is desirable to put in a double quantity to remove existing incrustation.

The nature and effect of this Composition are such as to enable the muddy sediment in the Boiler to be blown off whenever desirable, without diminishing the effectiveness of the Composition which remains. Particular attention is requested to the Testimonials from Messrs. Hewitt, and Messrs. James Braby and Son, as regards its application and effects on clean and dirty (incrusted) Boilers.

TESTIMONIALS.

"Upton Lovell Mills, near Heytesbury, Wilts,
"13th June, 1865.

"Mr. William Hewitt,

Dear Sir,—In reply to yours, we have pleasure in stating that, having used your "Patent Anti-Incrustation Composition," in two of our large Cornish circular boilers, since July and August, 1863, we can confidently recommend it as being a most efficacious article; NEITHER OF THE BOILERS HAVE HAD A HAMMER USED IN THEM since we began the use of the Composition, and our Engineer assures us that both of them are now as free from incrustation as when new, and have been so for some 18 months.

"We feel convinced that if the Composition were used in a new boiler, no incrustation would take place during its use.

"We remain, Dear Sir, Yours faithfully,
(Signed) "Hy. & Sr. Jno. Hawkrr,
"Cloth Manufacturers.

("N.B.—In explanation of the above, it should be stated that the trials were carried on in Messrs. Hewitts' Manufactory.")

"3, 5, and 23, Old-street, London, E.C.,
"16th June, 1865.

"Dear Sir,—We have tried your Composition in one of our multitubular boilers, and find it answers well for preventing incrustation. We intend adopting the use of it in future, and will recommend it as an article that will answer its intended purpose:

"We are, Dear Sir, Yours truly,
(Signed) RICHARD MORKLAND & SON,
"Mr. W. Hewitt." "Millwrights and Engineers.

"Patent Wheel Works, Newington Causeway, London, S.,
22nd July, 1865:

"Dear Sir,—We have much pleasure in bearing our testimony to the complete efficacy of your Boiler Incrustation Patent Preventive Composition. We put 14 lbs. into a 10-horse boiler, and at the end of 13 weeks had the boiler opened, and found all the old incrustation removed (I send you a specimen of it as swept out by the Engineer), and the boiler otherwise clean and uninjured. We have not found any ill effects whatever to the machinery from its use. It is our intention to continue its application, as it is far superior, in every way, to anything we have ever used.

"We are, Sir, Your obedient servants,
"Mr. William Hewitt." JAMES BRABY & SON.

"King's Road Wire Works, 135, King's-road, Chelsea,
"September 11th, 1865.

"Mr. Hewitt,

"Sir,—I can with confidence recommend your Patent Composition as being the most efficient compound yet introduced for the removal and prevention of incrustation in Steam Boilers. In order to test its capabilities, I applied it to my Boiler previous to its periodical cleansing: the composition remained in three months, and, upon inspection, I found the Boiler perfectly free from all traces of incrustation.

"I remain, Sir, Yours obediently,
"C. W. STANDISH."

N.B.—The Composition is now undergoing further trials in Marine, Locomotive, and Agricultural Engine Boilers, and the results will be published so soon as they shall be received.

HEWITT'S PATENT BLOCK COMPOSITION. Gentlemen of intelligence, energy, and integrity, liberally dealt with in undertaking the Agencies of Towns, &c., not yet represented. Apply by letter only, as above.

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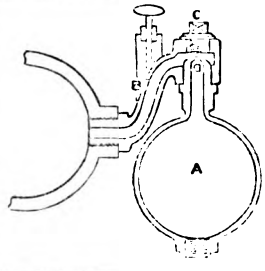

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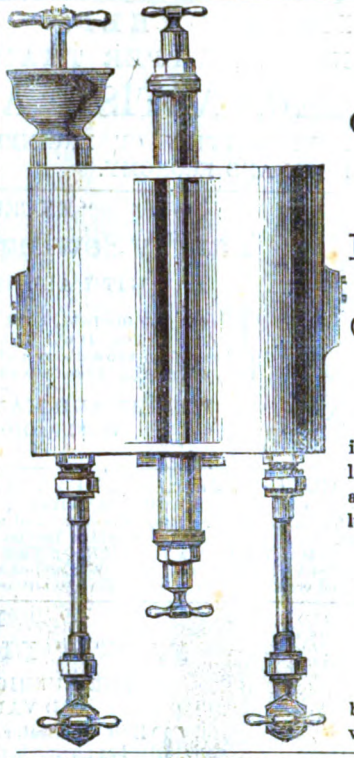

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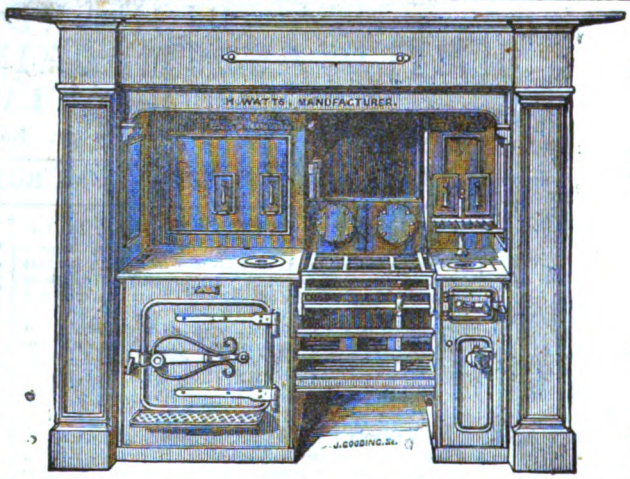

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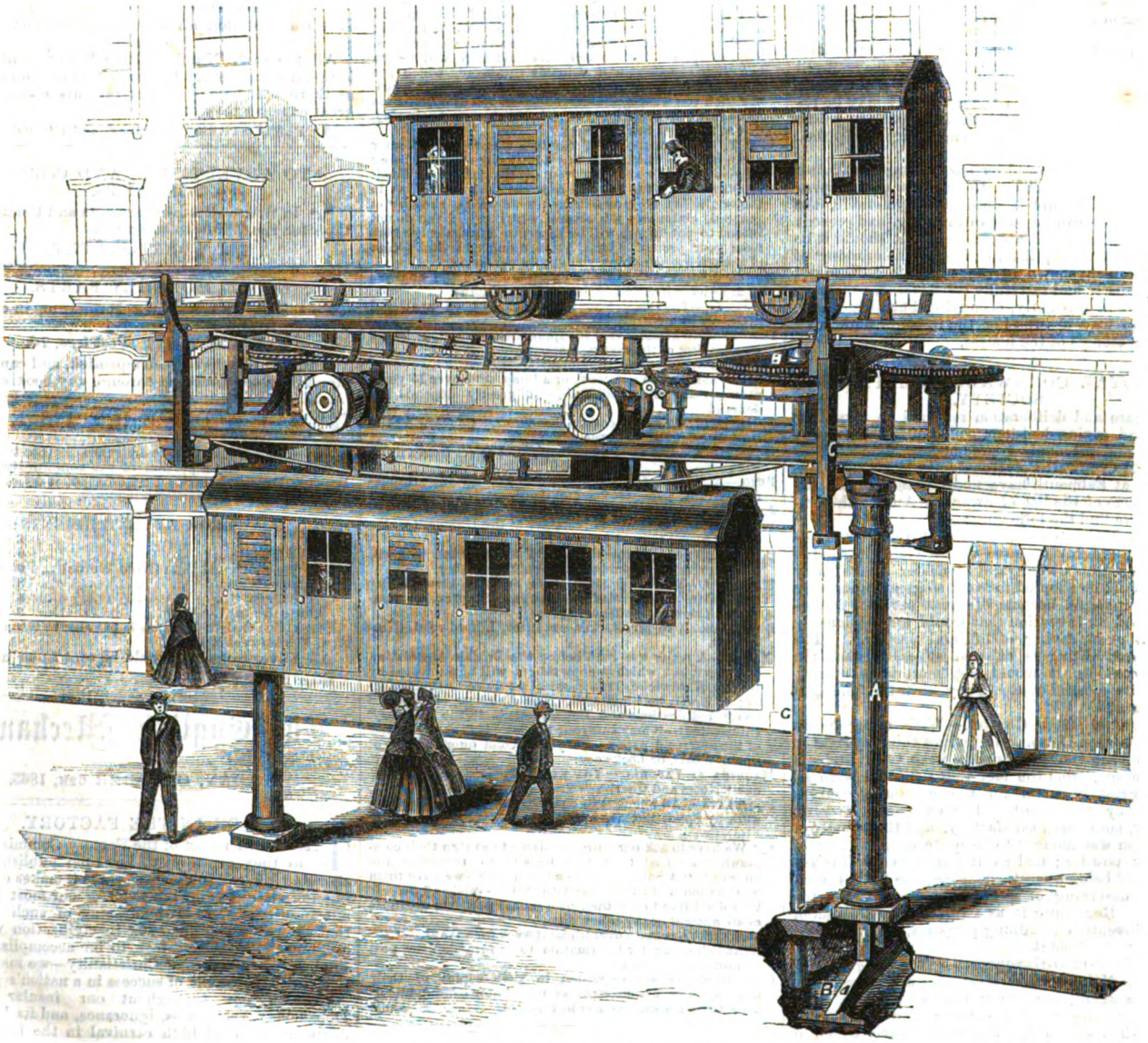

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For the purpose of reducing the car to the smallest space, it is made the width of a seat for two persons, the seat being placed across the car, and doors on the sides of the car for each seat, thus affording easy facility for egress and ingress. The lower cars are suspended from the lower tracks, the wheels being attached to the top of the car; the upper cars run upon the rails as upon other railways. All the cars are propelled by a succession of endless ropes, E, which are sustained at intervals by grooved wheels, F, that are fastened to the lower edge of the arm. The ropes will run the distance of two squares, or a greater distance, if found practicable.

The engines for propelling the ropes are placed under the sidewalk or in the cellars, putting in motion a vertical shaft, G, to which the rope-propelling machinery is attached; this machinery is simple, being two spur wheels, H, above two grooved ones that grasp the rope, so arranged by levers that the grooved wheels tighten upon the

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rope in proportion to the weight drawn. Each engine will propel two ropes; if the ropes extend 800 feet, the engines will be placed four squares apart.

The machinery for attaching the car to the rope is also simple, and so arranged as to prevent any shock at the starting of the car; the rope is permitted to slip until the car has attained the momentum of the rope. When started, the car will proceed to the end of the railway without stopping, or requiring the attention of any one, acting automatically—releasing its hold upon one rope, seizing the next in succession unless it is stopped at the stations, being entirely under the control of the person who attends to the stopping and starting of the cars. It is proposed, instead of sending conductors with the cars, to have two persons at each station—one to stop and start the cars, the other to receive tickets; if it is found necessary, a conductor may be sent with each car, who can stop or start it at pleasure by pulling or releasing a cord pendant from the top of the car.

Such is the construction of the railway that the cars cannot be run off the tracks; they are removed from one track to the other, at the ends of the road, by a sliding table, and in the same way may be removed at intermediate points, from track to track, or taken from the tracks, when necessary, and placed in depots.

The streets are crossed by suspending the frames that support the tracks in the manner of a suspension bridge. Should it be deemed preferable, the whole railway can be built in this way, and present a light and beautiful appearance; but should it be built supported by pillars, except at the crossing of the streets—as shown in the engraving—it would be, if properly and tastefully constructed, ornamental instead of unsightly, occupying but little space, and in no way obstructing the light, or darkening the lower storeys of the houses.

THE ROYAL CORNWALL POLYTECHNIC SOCIETY.

The care and deliberation required in awarding prizes and giving decisions concerning the various artistic and mechanical productions exhibited at the Royal Cornwall Polytechnic Society's late Exhibition at Falmouth have necessitated some delay in the issue of the list of awards. Among the official list we find the following:—

GALE'S METHOD OF PROTECTING GUNPOWDER.—The judges highly approve of Mr. Gale's method of protecting gunpowder, and consider that if any means could be adopted to avoid so great an increase of bulk, it would become of great national importance, and an invention that would unquestionably effect a great saving of life and property. The mixing and sifting is effected so easily that the judges consider it would not materially operate against its general use. They award it the first bronze medal.

PRENTICE'S GUN COTTON.—With reference to Prentice's Gun Cotton, the judges think it right to mention that the experiments were tried under a disadvantage, from the fact that the holes were all of too great diameter for the specimen charges brought by the agent. The experiments were, however, considered satisfactory, and the powder of the cotton was thought to be quite equal to that of ordinary powder; aud as it possesses also the advantage of being almost smokeless, the judges consider it deserving of a high testimonial from the society. Regarding it as a valuable application of an old invention to mining purposes, they award it the first bronze metal.

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INVENTOR.—If your invention can do all you say it is capable of doing, it is indeed a great one. But how to advise you in the matter we know not. There is no association of the kind you note, and were any such advertised we would think twice before we trusted it. Willingly would we send you instructions, did we know how; failing that, if you look at the matter in a mere monetary light, keep your invention till better days come. You might advertise for some one willing to assist you, or endeavour to get acquainted with a speculative manufacturer. Such, in several instances, have taken up inventions, and carried them through, to the profit of all concerned.

APPRENTICE.—"Practical Illustrations of Land and Marine Engines," by N. P. Burgh, £2 2s.; Spon, Bucklersbury; "Rules for Designing, Constructing, and Erecting Land and Marine Engines and Boilers," 4s. 6d., same author and publisher; "Engineering Drawing," (Armengaud and Le Blanc), 35s., Spon; then there are Blunt and Stephenson's work, Clark on the Locomotive, and others. Send to Spon's, 16, Bucklersbury, and they will return you their excellent and valuable catalogue, which see further; and keep it by you also to show your friends. We wish you well, and hope to hear of you as a first-class mechanic. Remember the school rhyme, beginning, "If at first you don't succeed."

A. F. T. (Grahamston).—Of the two we prefer the former arrangement, which has the additional value of being ship-shape. We are glad you overhauled Mr. Woodcroft's volumes, for you will have satisfied yourself as to the originality of your scheme; with which, should you proceed, claim also the second working. If you do not intend to patent, we will be happy to illustrate the idea from your *present* sketch, you sending us a *description* of the other. We think you should persevere.

MODEL ENGINE.—Consult a cheap work on the engine; such as have been advertised in our columns.

R. H. U.—Thanks. The inquiry has been answered privately by a correspondent

INQUIRER.—Will endeavour to supply the information. There was nothing of the madman about him.

W. SPARROW.—See back numbers.

BEN JONSON.—Five per cent., or a lump sum over 15 years at a certain estimated sale. It greatly depends on demand.

J. HICKMAN.—A stamp carries the *Guide*. Concerning the straight-edge, write to the advertiser.

H. LE NOIR.—Get Spon's catalogue, and select from a number there.

PETO.—Vol. IV., Holtzapffel's work has various arrangements in it. See "Notes and Queries."

J. H. W.—Answered by another.

WOULD-BE B. SC.—Send to secretary at the University. He will be happy to send you the information.

C. H. Southwell.—Many thanks. You will think with us, there is no gain in pursuing the matter further.

H. BROWN.—You can procure them by order, through any bookseller. The method was illustrated in previous numbers. There is no offence.

DRUID.—Send to Mr. Parker, engineer, Lilford-road, Camberwell.

C. J. C.—A paper was read before the British Association on the subject, which, among others, will be published by Robert Hardwicke, 192, Piccadilly; write to them, asking if it will be illustrated. The *Engineer* of Sept. 22 has "Modifications and Improvements in the Injector," (illustrated)—it may suit your purpose; it is by the author of the aforesaid paper. To your second query: order of Spon, Weale, or Lockwood.

MACHINA VI VAPORIS.—You won't get it done for less. See "Notes and Queries."

POSTULATA.—All about it in chap. 3, vol. iii., Holtzapffel's work by Spon, Bucklersbury.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

ANGLO-FRENCH ENGINEERING COMPETITION.—The Graffenstaden Works, in Alsace, have obtained the contract for 22 out of the 46 locomotives for which the Baden Government recently invited tenders, the remaining 24 being taken by local Baden manufacturers. The respective prices demanded were—by the French manufacturers, £1,800; by the Badeners, £2,228 16s.; and by the English, £2,828 16s. each.

ATLANTIC CABLE.—It is proposed that on the next attempt to lay an Atlantic cable two separate ones should be used. The shore ends being secured at Valentia and Newfoundland, the cables may be paid out simultaneously; when arriving at a certain point a splice may be made and the entire cable committed to the deep. Had this course been adopted the late fatal disaster would have been avoided.—*Notes and Queries.*

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The English Mechanic.

FRIDAY, OCTOBER 6TH, 1865.

WORK IN THE FACTORY.

THE fourth report of the Factory Commissioners, as they are termed, has been published, and shocking indeed are the disclosures it makes concerning the state of things in some of our most important industries. It is the issuing of such reports that shows us how far back in civilization we still are, and the herculean task to be accomplished ere the healthy influence of Christianity—we may mention it as an element of success in a nation's growth—can be felt throughout our insular home. Debauchery, selfishness, ignorance, and its brood of degradations hold high carnival in the land; and we do not know whom to blame most, the masters who employ and pay no heed either to the moral or physical welfare of their workmen, or the workmen themselves. We learn yet again that a very old man is the Sheffield grinder at 42; and that he has lived a "tidy life" who struggles on to 36! The children, too, continue to be dreadfully neglected, according to the evidence given before the various reporters. One little fellow of 14 had been at work at cutlery half his life, and he in evidence said, "I don't know of London, or of Queen Victoria, or if she is a woman, or takes care of the country." Another one, asked concerning the Queen, said, "Have heard the name on it—can't tell what it means. She finds 'em money." Another poor little chap "thinks there are about 32 pennies to half-a-crown—that four times four is eight—that we have a king, (told it is a queen), they call her the Princess

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Alexandra. (Told she is married to the Queen's son), the Queen's son is the Princess Alexandra; a princess is a man." A boy aged 12, stated, "I don't know anything about the Queen or England. Don't live in England. Think it is a country, but didn't know before. There are six days in a week." And yet our missions to all parts of the world, excepting home, cost millions annually! It may be said this is not an engineering matter; perhaps not, but engineers and mechanics in general are men, and it is to men we speak.

Referring to the grinders, the Commisioners point out that the adoption of a mechanical contrivance called a "fan," would at very small expense be a great advantage. They consider, as do we, that the injurious effects of night-work upon the constitution, the habits, and morals of the young warrant a recommendation that legislation should prevent any person under the age of 18 being subjected to such labour at night. The operation of the Factory Act should be extended to these trades, and the law carried into effect, even in small shops and houses where such avocations are pursued. A like provision should be made in every trade, we care not what it may be, or where carried on. The tale from the seat of glass making, artificial flower making, needle making, and other trades in which female and youthful labour is required and used, is truly heart-rending, and cries aloud for help for the helpless. We who are so ready to cry shame when any act of an extra oppressive character is done in any other country, have reason to blush for ourselves. The population may be growing better as a whole, but we fancy much is left unrecorded through the super-refinement or laxity of the laws; certainly the reports from time to time issued like unto the one we are now noticing, tend to give the lie to the oft-repeated statement that we are growing better as a nation. For one, we don't believe anything of the kind; we believe that selfishness is more widespread now than ever it was in the history of the land, and that a cheap press is daily accumulating the facts in proof. Nor will this lamentable state of things be altered until men seek for the reception of good in bestowing it on others, that simple "doing as we would be done by," which yet seems so very hard a task. At all hazards the youth of both sexes must be protected from selfish rapacity, and we hope to see the recommendations of the Factory Commissioners carried out without a day's unnecessary delay.

ON THE APPLICATION OF SPECTRUM ANALYSIS TO MICROSCOPICAL INVESTIGATIONS.*

By H. C. SORBY, F.R.S.

(*Concluded from page* 8.)

Though in actual practice many other facts may turn up to render special modifications necessary, yet the following is the method I should adopt in examining a mark or stain supposed to be due to blood, assuming that only a small quantity was at my disposal. I should first cut off a portion of the material where not marked, and digest it in four or five drops of water in a watch-glass, squeezing it with forceps, and moistening it over and over again. If the solution became coloured, I should introduce it into a cell and determine the character of the spectrum, both in its natural state, and after having been acted on by the different reagents already mentioned. I should then add a very little blood to a few drops of water, and digest in that solution a small piece of the material, so as to make out whether it contained anything that acts on the colouring matter of blood. Having satisfied myself on these points, I should cut off a small bit of the stained portion, using from 1-10th to ½th of an inch square, according to the character of the mark, and the amount of material at my disposal, and digest it in three or four drops of water in a watch glass. If the solution became well coloured, I should not squeeze the material so much as to detach many minute particles of foreign matter; but if there appeared to be very little colour present, I should dissolve from it all I could, and take care to waste as little solution as possible, and have no more than would properly fill the cell. Transferring the solution to a cell about ½ inch long and ⅛th inch in diameter, and having placed it horizontally in front of the slit, and left it a short time, so that the minute particles of foreign matter might settle to the lower side of the tube, I should examine the spectrum, and carefully note the exact position and general characters of the absorption-bands, if the solution were too strong, diluting it until they were well seen. If the spectrum were like No. 2, I should feel nearly sure that the mark was due to blood; and, if it had been kept dry in a town, I should also conclude that it was nearly fresh. If it were as No. 4, I should feel inclined to believe that it had been exposed to the air for some time; but, unfortunately, the character of the atmosphere makes so much difference that no rule can be given. If, however, in any particular instance a knowledge of the length of time that had elapsed since the blood was fresh were of importance, a more definite opinion might be formed after a few days' experiment with fresh blood, keeping it, if possible, under the same conditions, and using the same material as in the case in question. If the spectrum obtained was like No. 4, I should add ammonia in excess, so as to obtain one like No. 5, and afterwards add citric acid in excess, so as to see spectrum No. 7. Then adding excess of ammonia and a small quantity of protosulphate of iron, stirring it to dissolve all the oxide, but not so much as to peroxidize and make the solution so yellow that it would not transmit the green, the spectrum No. 8 would be well seen, even when a very small quantity of blood had been present. If plenty of material remained, I should take another portion, dissolve the blood from it, add citrate of ammonia, taking great care that the solution was never acid, and then deoxidize by means of a little protosulphate of iron, so as to obtain No. 6; and I should also mount a dry specimen on glass, to keep as a permanent proof. If all the characteristic results followed, I think no one could hesitate in giving evidence that the mark was blood; though, of course, these facts alone would not decide whether or not it was human—if possible, that must be accomplished by other means, or a conclusion formed from other considerations.

If the quantity dissolved out at first gave a very faint spectrum, it would be well not to attempt to see the spectra Nos. 5, 6, and 7, but to act on the solution with citric acid, filtering, if requisite, and then to add ammonia and protosulphate of iron, so as to obtain No 8. The material itself might also have so acted on the blood that no other spectrum could be seen. It is, however, so characteristic, that, even then, one could scarcely hesitate in deciding that the stain was due to blood.

If the material had evidently been washed, so that no spectrum could be obtained from a simple solution, having first ascertained what effect citric acid has on the dye, I should digest a stained portion in a solution of ⅓rd or ¼th of a grain of citric acid in a few drops of water, so as not to have more liquid than will fill the cell, filter, if requisite, add excess of ammonia, and then protosulphate of iron. Unless very thoroughly washed out whilst the blood was quite fresh, no mere washing with hot or cold water without brushing or other mechanical means being adopted to dislodge the minute insoluble particles, will so completely remove the stain that it could not be detected in this manner; except, indeed, any of those foreign substances be present which precipitate the colouring-matter in a form insoluble in citric acid and ammonia.

Supposing a clear coloured solution be obtained, which gives a different spectrum or set of spectra to those characteristic of blood, it might be desirable to ascertain the nature of the substance to which they were really due. I have already described the spectra of a few colouring-matters, but in all cases I strongly recommend the study of the spectra of any substances likely to occur in any particular instance. Even if blood has been detected, this would also be desirable, since an opinion could then be given with more confidence.

My conclusion is that, even in cases where the usual tests would fail, the detection of minute traces of blood need not in general be a weak point in the evidence of crime. Having proved it to be present, the question of its having been human or not must be decided by other considerations; and thus as a positive proof the evidence may be equivocal: but if a stain supposed to be due to blood, which, if it were, would certainly give the characteristic spectra, fail to do so, the negative evidence would be decisive.

It is, of course, at first, always difficult to know to what subjects a new form of apparatus may be usefully applied; but I trust that the facts I have described will suffice to prove that, for so simple an addition, the resources of the microscope as an instrument of research are greatly increased by our being able to use it also as a spectroscope.

* Extracted from the *Quarterly Journal of Science*.

We learn that Count Castracane, at Rome, has employed a monochromatic light for the microscope with excellent effect, and has found by experiment that greenish blue is the tint most favourable for observing extremely delicate organization—such as the pleurosigma angulatum; the lens required is of less power than when white light is employed.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

Sir,—I observed a curious-looking contrivance on a steamboat on the Rhine. Each crank was in two parts, set at an angle of about 40° to each other, and connected by a thick strap or link of brass, with three slots in it; the links were about 6 or 8 inches long. Can any of your readers explain this? (The engines seemed to be high and low pressure.)

In reply to "William Taylor," I quote from Holtzapffel, page 1,404, (using the pruning-knife here and there) Every coat of varnish or colour is dried by placing the object in a stove, heated by flues to a temperature as high as can safely be employed without injuring the articles, or causing the varnish to blister or run. The colours for ornamental works are ground in linseed oil or turpentine, and mixed with copal or animé varnish for working.

Metal works are cleaned with turpentine. Ivory black is mixed with dark animé varnish for the ground of black works, and three or four coats of japan are applied.

Can any of your readers tell me the price of a good, strong, plain slide-rest for a 6 inch lathe for metal work.

C. SWEET.

South Lodge, Kilburn Priory, St. John's-wood, N.W.

Sir,—I regret that Mr. Merritt should consider the two chucks so much alike that I was needlessly occupying your columns by sending the description I did.

If, however, as he thinks they are nearly identical, I can assure him that the one I sent is described in Holtzapffel's catalogue, 1853, item No. 1557.

THOMAS. A. COTCHETT.

OUR SUBSCRIBERS' NOTES AND QUERIES.

TELEGRAPH BELL.—How can I construct a telegraph bell to be worked by a single wire from one house to another, and will the same wire do for return signals?—WM. JENKINS.

PATENT INDIA-RUBBER DECKLE STRAPS.—Is there a composition for, or method of, splicing these, or stopping them from cracking?—JOHN SUTTON (Paper-maker).

BESSEMER STEEL TOOLS.—Where can I get a best-tempered graving tool for cutting pearl? Does any one make and supply gravers made from Bessemer steel?—COMPOS.

BOILER PLATE.—What thickness of plate should I use for a boiler 4 feet by 1 foot, to bear a pressure of 80 lb. per square inch—and the rule?—R. E. MELLOR.

ECCENTLIC CHUCK.—How can I make such for amateur! How to adapt overhead motion to ordinary 5-inch iron bed lathe (for drilling and cutting grooves with cutters)?—PETO.

RHUMKORF COIL.—Will Mr. Parkinson give me size of bobbin for this coil?—J. JOHNSON. [No room to insert description if obtained. Send privately to the gentleman. ED. *E.M.*]

CEMENT.—Wanted: a transparent cement for glass, such as used by opticians?—R. W.

STRENGTH OF ROPES.—Presuming the breaking strain of 4-inch rope to be 5¼ tons, the same being used as a purchase with a double and treble block—there being six parts of the rope—what is the maximum weight?—W. P. GIBBS.

GAS PURIFIER.—How have I such a heavy pressure on mine? I have no exhauster. What is the best remedy?—VESTA.

PISTON HEAD.—What substance had I best employ in making a piston-head to act in a cylinder ¾ inch in bore, so as to keep it perfectly fluid tight—the piston having to lift a weight of 8 lbs.—DELTA.

HARDENING SPRINGS.—How can I harden wagon springs?—H. SMITH.

ELECTRIC CLOCK.—Will "A. Watson" (Leeds) tell me, is there a book extant giving a full account of the clock he mentions?—W. T. W.

COLOURING FLUID.—The names of different substances forming different colours, when dissolved in spirits of wine, or prepared any other way, or such as used by calico printers—or the name and price of a book on the subject?—JOHN CLYD

PAPER BAG MACHINERY.—Who is the maker of these machines? or, where are they to be had?—J. H. B.

BOILER.—What size of boiler is necessary to work an engine consisting of cylinder, 5 inch stroke, 2½ inch diameter, with top and bottom cap, piston, slide box, and valve? It is required to drive a foot lathe.—MACHINA VI VAPORIS.

ELECTROLOGY.—How can I electrotype steel or iron with copper, silver, or gold—the battery and power?—KNOBSTICK

ECCENTRIC SHEAVE.—How best to mark off an eccentric sheave—the angular line of advance, so it can be placed on the shaft in proper position at once? also, how to find the lap and lead of the slide valve?—ECCENTRIC.

SCREW.—How is the screw cut in the wheel of an eccentric chuck for a tangent to work in?—W. G. P.

MICROSCOPE.—How to construct a cheap and powerful microscope—giving glasses.—JAS. A. HARVEY.

LATHE CENTRES.

Sir,—In tool shops the centres are all turned to an angle of 90 degrees. THOMAS JACKSON.

Sir,—The proper angles for the centres of an iron turning lathe are, for very large work, 90°; for general, do, 80°; and for light, 70°. On no condition have your centre over 90°. WM. SHEDDEN.

Albion Works, Paisley.

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Sir,—In answer to "Systematic," I believe 45° is the best angle for lathe centres.

"J. Patts" should try the recipe given by Mr. Babbage, viz.:—

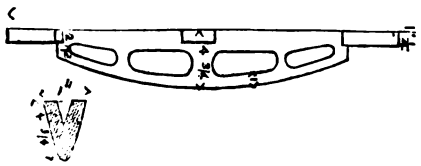
Scratch a cross on one side of the glass; next fix a centre punch in a vice with the point upwards; then get some one to hold the glass, so that the point of the centre-punch touches the centre of the cross; take another centre punch, and hold it exactly over the point of the lower one; give it a smart blow, and a perfectly round hole will be the result. Cone-Pulley.

BOILER PRESSURE.

Sir,—In answer to "J. Soundle," in No. 25, he would have a pressure of 11½ pound per square inch, or a pressure of 9,720 on the entire surface of the boiler. The size of the tube making no difference, a ⅜ tube will exert the same pressure as a 3 inch tube. R. E. Mellor.

FURNACE BARS.

Sir,—No one having answered "Steam Mills'" question about furnace bars, I send a rough sketch of one I put in



about 3 years ago, and now to all appearance they are as good as when first cast; the current of air through them keeps them quite cool, and they may be made and used by anybody. The space between bars ⅜. Thomas Jackson.

VARNISHING WOOD.

Sir,—In reply to "Diamond," I will endeavour to instruct him about wood before varnishing. Supposing it is deal for instance (or any other wood), he should first "stop" it with putty coloured to match wood; then rub off rough edges of stopping, and make some glue with strong size (2 lbs. of glue to one gallon of water); from which, after boiling, take some out into a paint pan, and let it get half cold—that is, until it begins to thicken; then apply it to the wood with a pound brush. Let the size get dry, and varnish with one or two coats. If sized twice, the gloss will be richer. This is the plan I have used most successfully. S. R.

WINTER'S ELECTRICAL MACHINE.

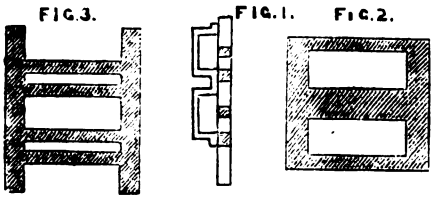
Sir,—In answer to "Round Head," I received a very clear description of Winter's electrical machine from Mr. Hart, having written to him privately asking him to communicate either through The English Mechanic, or privately; he did the latter in a most obliging manner, and I have no doubt if he sees "Round Head's" letter he will get an answer. Should anything prevent, I shall be most happy to send a drawing and description.

F. T. Parkinson.

Ashton Villa, St. Mark's, Cheltenham.

STEAM PORTS.

Sir,—If Mr. Jamieson arranges one cylinder to work with the ordinary slide valve, and the other with Worthington's steam valve, he will then have the steam on the same side of both pistons when one valve is up, and the other down. A glance at the enclosed sketch will shew the



action of the Worthington steam valve. Fig 1 is a view of the valve with one port open to steam, and the other to exhaust; fig 2 is the valve face; fig 3 the valve seat.

M. J.

MAKING PRINTER'S INKS.

Sir,—In answer to "Nemo," Leeds, the following may prove useful to him:—Grind the colours with printer's varnish and dryers to the thickness required. Any shade may be produced by mixing the following colours:—Red: to pale vermillion add carmine. Bright pale blue ultramine, deep bronze blue, Chinese (?) To make black ink for printing, take linseed oil, and heat in a proper vessel till it begins to boil; then remove it from the fire, and kindle the vapour. Allow it to burn until it becomes stringy—then add gradually, to every quart, 1 lb. black resin (which dissolve and add cautiously), and 4 ozs. dry brown soap shavings. Set the mixture on the fire, and stir it until combination is complete. Next, put into a suitable vessel 1 oz. finely-ground indigo, 1 oz. fine Prussian blue, and 18 oz. fine lamp black for every pound of resin employed; pour the liquid on the colours, well mix, and then grind in a mill. J. Newton.

[We hope "Nemo" *now* understands the matter.—Ed. *E.M.*]

HOT WATER PIPES.

Sir,—In answer to "Ironmonger," in greenhouses, conservatories, and such like buildings, where the temperature is required to be kept at about 60°, divide the cubic measurement by 30, it will give the required quantity of pipes; if for forcing houses, where it is desirable to keep the temperature in the coldest weather at 70° to 75°, divide the cubic measurement by 20, to obtain the number of feet of 4 inch pipe, but if the pipes are to be 3 inches, add one third to this quantity; if 2 inch pipes are used, double the length of 4 inch pipes. As for boiler, I think he will find the saddle back the best. Thomas Jackson.

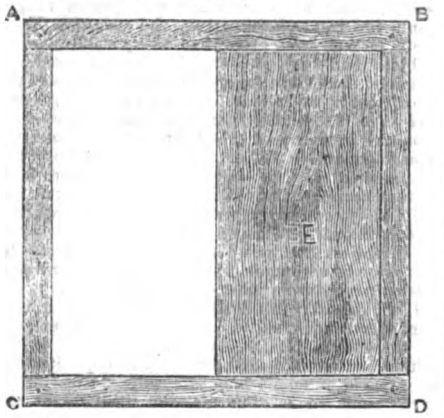
[See also Weale's "Rudimentary Treatise on Warming and Ventilating," 2s.]

SLAG FOR POLISHING.

Sir.—Iron slag, prepared as described in No. 26, has long been used in Scotland for polishing steel. Gamma.

DOUBLE PHOTOGRAPHS.

Sir,—Respecting the "Double Photograph."—The great secret is this, viz:—That you expose one half only of your sensitized plate at once; which is readily accomplished by a moveable shutter, which any of your readers may easily construct from the accompanying diagram.

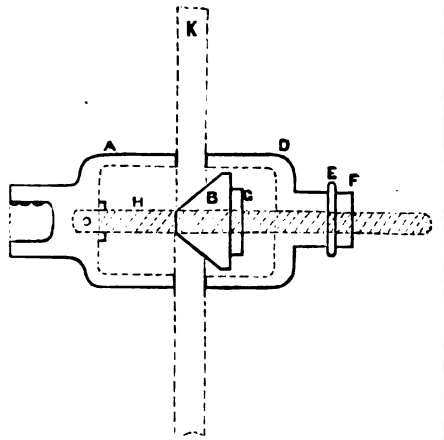


A, B, C, D, is a light wooden frame made to fit tightly inside the camera *just* in front of the dark slide. Inside this frame is a groove in which the wooden shutter, E, slides backwards and forwards from the side B, D, to the side A, C, or *vice versa*, thus alternately exposing the right and left hand side of the sensitized plate. Thus, when you have exposed the left hand side of your plate for a sifting picture, you remove your dark slide for a second, whilst you push the shutter E to the other side of the shutter-frame. Replace your dark slide, and take a standing, or any other picture, on the right hand side of your plate. Care must be taken to have the shutter extend exactly to the centre of the frame, and to have an immoveable object, such as a table, &c., form the middle of the picture.

The shutter must be blackened with a mixture of lamp-black and water to prevent reflection. R. B. Wegg.

DISK CHUCK.

Sir.—I send you a slight sketch and a description of a "disk chuck," asked for by one of your correspondents.



A is a cup chuck having a screw H fixed in its centre, so that it will turn correctly in the lathe. B is a cone with a hole drilled through its centre, and made to fit the screw H, but so that it will slide along it, not screw. C is a small nut. D is a kind of cup which also slides along the screws H. E is a washer, and F is a nut.

To use the chuck:—Put on the disk K, slide up the cone B till it centres it truly, then lightly screw up the nut C, just sufficient to hold B in its place and no more.

Next, slide up the cup D till it presses against the disk K, put on the washer E, and screw up the nut F tightly, when you will find your work held firmly.

Mind the cone B has nothing to do with the holding the work, its duty being merely to fix it truly central.

An Amateur Turner.

COPPER WIRE.

Sir,—Your invaluable correspondent, "G. F. Williams," in the plentitude of his information, must be careful lest unwittingly he should mislead some of the innumerable querists who make known their wants, &c., through the medium of your valuable journal.

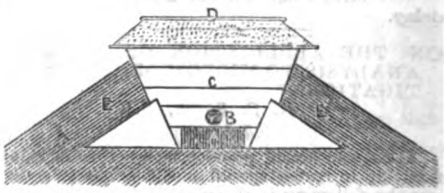
I would respectfully ask "G. F. W." if he can furnish me with the diameter of the "No. 35" copper wire which measures about one mile to a pound (when covered with silk, I presume)? And if unable to do that, will he kindly inform me what gauge he uses to get at the number—If the B. W. G., he is certainly in an error, as No. 35, according to the Birmingham gauge, will not measure 1,500 yards to the pound uncovered, and a pound covered with silk would be at least 100 yards less than that; nor do I know of any gauge in use at the present time which would give one mile (about) of No. 35, copper wire to the pound. A size finer, or No. 36, would not be a mile to the pound by a tolerable stretch.

If, however, your correspondent's friend, Mr. S. Scrace, Salford, can furnish good copper wire well covered with silk measuring about one mile to the pound, (no matter what number he calls it, the length is the test, and that is regulated by the diameter) his covering apparatus need never be idle, if he can supply it at 12s. 6d. per lb., since there are large consumers in London who would take it by the cwt. at such a price.

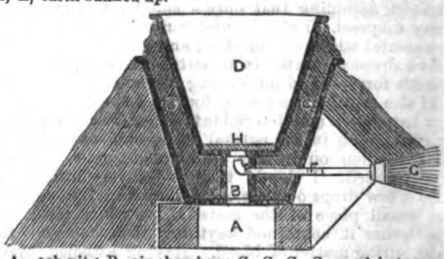
The fact of the matter is, a pound of copper wire of high conductivity drawn to measure one mile, together with the silk requisite for covering it efficiently would cost more than the money, consequently the tedious and very nice, and I may say delicate process of covering, and winding so fine a wire would have to be done for nothing; and the covering of such wire, I may add, is a process requiring very nicely adjusted and expensive machinery. S. Taylor.

A SIMPLE FURNACE.

Sir,—In reply to "Amateur Mechanic," I call his attention to the following simple furnace, which will cost him little or nothing to construct. I describe it for the benefit of all English mechanics, readers of your invaluable journal. Procure two sound flower pots, one about 12 in. high, the other 9; the larger one should have holes along the side near the bottom in addition to the one in the centre of the bottom; one of these will do for the blast hole. The hole in the bottom, of each must be carefully knocked out to a circle of 4 inches diameter. Proceed to bind them round with iron wire, as they will crack with the heat, then choose the place in which you purpose placing the furnace, and lay two bricks parallel to each other four inches apart; on these place the larger pot, and put the smaller one on it, keeping them about an inch apart with sand rammed tight. To prevent the same running out at the bottom, make a ring of tin with a hole for the blast. Some short pieces of thick iron wire will do for the furnace's fire bars; now bank the furnace well up with earth, and it will be complete. Coke and charcoal mixed is the best fuel, but if not to hand coal will do. When the fire has burnt brightly place the crucible in it and cover it with coke or coal. Ten minutes blowing with the kitchen bellows will melt brass. I append diagrams:—



A, ash-pit; B, hole for blast; C and D, flower-pots; E, E, earth banked up.



A, ash-pit; B, air-chamber; C, C, C, C, sand between pots; D, body of furnace: E, E, blast pipe; G, bellows: H, fire bars. Edward McGurk.

WATER AND SPIRIT GAUGE REGULATORS.

Sir,—The water gauge regulator mentioned by "Underbands" may be made as follows—Obtain a piece of glass tubing say ½" diam. × 6" long, cement on the two ends brass caps; a small hole should be perforated in one of these caps, in order to allow a thin rod or bar of metal to slide backwards and forwards within the glass cylinder, so as to form contact between the two capped ends when necessary. Next fill with water and attach the two capped ends respectively to the two ends of secondary wire. This instrument acts as a second channel, or shunt for the current to travel. By withdrawing the bar from the glass tube the shock is increased, when pressed in diminished, because when pressed in the shunt is shortened and less resistant than the human body, allowing a greater proportion of current to pass by this channel, thus lessening or leaving a smaller portion available for giving shocks.

A decomposition of the water in the glass tube will gradually take place, causing bubbles of gas to be liberated, consequently the water should be replenished occasionally for this purpose one of the brass caps should be made to unscrew when required.

Spirit regulators are often used for the purpose indicated by "Underbands." In their construction they are essential

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the same as the one I have described, with this difference, the tube is filled with spirits of wine, and one end attached to one of the secondary wire and the other to the party undergoing the shock.

The action of this kind of regulator is the reverse of that of the water gauge. Spirits of wine, it is well known, offers an immense resistance to the passage of a current of electricity; the shock is therefore in this case reduced by withdrawing the bar, causing the current to pass through a greater portion of the resisting fluid, thus weakening it before arriving at the party receiving the shock, and by the same reasoning the shock is increased by pressing the bar in.

Earthenware pots can be purchased for a very few pence, at almost any electrical instrument maker; the name of several have been given in previous numbers.

EDWIN FURZE.

PLATINUM BRONZE.

Sir,—After failing (in a large city) to get platinum bronze, I dissolved platinum wire in nitromuriatic acid, heating and evaporating to dryness, getting an orange residue. On adding water to this, a deep yellow solution resulted; brushing clean brass with it, as "Electra" directs, some parts were jet, some grey, and, by the time the moisture had gone off, so also had both black and grey. There was a clean coat of platinum left only. I tried it with and without heat, washing, &c, with no better result.

By any friend pointing out faults in my manipulation will much oblige GAMMA.

AMMONIA ENGINE.

Sir,—On referring to No. 26 of THE ENGLISH MECHANIC, I see that your correspondent, Edward Payne, wishes for further information concerning Tellier's ammonia engine.

I am informed by a gentleman who has recently returned from the Continent that the invention mentioned in No. 1 of THE ENGLISH MECHANIC has been abandoned, and has so far proved a failure; but so far from the idea of using ammoniacal gas as a motive power being an impossibility, I am glad to inform you that in the course of a few days we shall have brought before the public an ammonia engine which has recently been patented in this country, and also on the continent, of which a model was shown at work to several witnesses in May, 1864, and had been explained to several gentlemen in the Feb. of the same year (which is previous to Mr. Tellier's invention), and which I have no doubt will prove a powerful rival to steam.

If Edward Payne will be good enough to forward his address to M. Van Waegenberch, 18, East Parade, Newcastle-on-Tyne, who is the original inventor of the ammonia engine, he will receive full information on the subject, which I have no doubt will prove of interest to him as well as to many others. N. H.

LATHE CENTRES.

Sir,—For the information supplied to me by your kind correspondent, J. M., respecting Lathe Centres, I certainly feel greatly obliged to him. If some of your correspondents, perhaps, J. M., could inform me how to fix and turn on a lathe, the journals of a crank shaft, it would oblige. It is of cast-iron, there are three journals one on each side of the shaft, and the other on the crank, the radius of the crank is 1 ft. 6 in. The length of the shaft is about 8 feet.

SYSTEMATIC.

J. SOUNDLE'S QUESTION.

Sir,—Your correspondent, "J. Soundle," must have been somewhat perplexed at having two such different answers to his query, as appeared in No. 27, from "J. Newton" and "X. Y. Z;" but, notwithstanding the discrepancy existing between their two calculations, both of them are right. The blunder originated in the vagueness of "J. Soundle's" question. He does not say whether his 24-feet tube is square or cylindrical. "J. Newton" assumes it to be the former, and "X. Y. Z." the latter—hence the discrepancy.

Your compositor has also omitted to place the decimal point before the figures "·341" in X. Y. Z's letter, which would mislead any one not acquainted with the weight of water. W. G. W.

DRILLING GLASS.

Sir,—The best and safest method of drilling glass is to use a brooch. No spear-pointed drill can be tempered hard enough not to break. The brooch can either be used as a drill with a bow, or by the hand. It should be selected of such a bore that it will make a hole of the required size, at about one inch from the end. It should be broken off sharp with a pair of plyers, at about an inch and a half, and when the sharp edges are blunted by drilling a fresh end should be made by breaking off an eighth of an inch, and so on, until the hole is bored. It is always desirable to drill from both sides, as it prevents the glass from breaking; drill lightly. Fine emery and oil, I think a better lubricator than turps. TIMOTHY TWIST.

PERPETUAL MOTION.

We have received some dozen letters on perpetual motion, to which we cannot give space; we have room only for what can be of value to our readers.

FURNACE BARS.

"Steam Mills" to "J. S"—Please address, H. Pritchard, Lower Regent-street, Hinkley.

A PROSPECTUS has been issued by the committee of the Manchester District Art Workmen's Association, announcing that it is their intention to hold an exhibition of arts and manufactures early next year.

THE MATERIAL IN IRON SHIPS.*

By Messrs. T. TATE and W. FAIRBAIRN.

A paper, jointly contributed by these gentlemen on "The strength of material considered in relation to the construction of iron ships," excited considerable attention. It was of a highly technical character, but its conclusions are of considerable importance. In the paper the quality of iron was estimated by the work expended in the ultimate elongation of a bar one foot long and one square inch in section. This work or dynamic effect, gave a comparative measure of the powers of resistance of different kinds of material to a strain of the nature of impact. The values of this modulus or co-efficient of dynamic resistance, determined by Dr. Fairbairn's experiments for different plates or bars of iron, showed that the resistance of thick plates to rupture was about 2½ times that of thin plates, that the resistance of thick plates are about one-tenth greater than that of the Low Moor iron plates A, and that the resistance of these latter plates was one-half greater than that of the rolled plates D. Similarly the work expended in the deflection of a bar, supported at its extremities by a force applied to its centre, might be taken as the modulus of dynamic resistance to a force of impact tending to produce transverse rupture. The next section of the paper gave the *maximum* transverse strain produced on a ship when the load was unequally distributed. The point of *maximum* strain was not always at the centre of the ship, as many practical men assumed. The third section of the paper gave the value of the moment of *inertia* for different elementary sections of material. Section four gave a certain simple general analytical expression for the moment of *inertia* of complex sections of girders, such as that of an iron ship. The distribution of the material, so that the beam might have the greatest strength, was next investigated; and the formula applied to the section of one of our most approved iron ships showed that the upper portion of the ship should be about one-half stronger than it was in order to have a proper distribution of the material. Section five treated of the penetration of iron armour-plates by flat-faced tempered steel shot. The following formula, derived from Dr. Fairbairn's experiments upon punching, was given. The work requisite to penetrate a plate varied as the square of its thickness, multiplied by the radius of the shot, or $V = C\ r\ t^2$. The constant of this formula, deduced from the experiments with ordnance, might be taken as 24400. It was shown from this formula that a 100lb. steel shot, five inches diameter, with a velocity of 1,200 feet per second, would completely perforate an armour plate exceeding five inches in thickness.

ON THE CAUSE OF THE VIOLENCE OCCASIONALLY ATTENDING THE EXPLOSION OF STEAM-BOILERS.

(*Concluded from page 3.*)

As a visible force steam cannot be said to exist. It is the name only for an effect produced in certain atmospheres by the operation of heat. In other words, steam is water and heat together—simply water and heat. If this heat could be conveyed as effectually into the same situation by any other means, the same results might be expected to follow, viz., the expansion of air into force or pressure. The brothers Montgolfier inflated a large balloon simply by altering the nature of the atmospheres within by the application of heat, and a force was attained which lifted themselves and their huge apparatus up to a great elevation.

The force which resulted in this case was probably greater than could have been obtained from steam machinery, as in all attempts to accomplish aerial navigation by the force of steam the weight has exceeded the power. So that it is apparent that great mechanical results may be attained by a trifling variation of the specific gravities of bodies, and that this may lead to results which cannot be arrived at by the employment of absolute forces developed by other means.

It is worthy of being borne in mind that water cannot be decomposed by heat. At all the stages of evaporation through which it passes it is normally present and has assumed no new qualities whatever. Many other bodies besides water possess the property of undergoing an entire change in appearance without losing any of their original qualities or assuming new ones. Resin, for instance; in its natural state or ground down into powder is different only in the singular variation of colour which results upon its being reduced from one state to the other. This is the case also with glass and several other bodies. Each of these substances may be made to resume their natural features by a process of reconversion effected by heat. In their usual state they have an approximate smoothness and solidity, and when pulverized they resemble one another more closely in opacity and colour. But the most important illustration perhaps of this parting with, and re-assumption of the natural properties of bodies is that exemplified in the conversion of water into steam, and the reconversion of steam into water. Whatever may be the nature of the change caused in a mass of water by its absorption of heat or the passage of heat through it escaping at its surface in the form of bubbles, it is held to be impracticable to reduce steam to water again without the absence of heat. Now it is commonly known that a quantity of water placed under the receiver of an air pump will, as the exhaust is carried on, appear to evaporate with great violence. The resemblance to the phenomena observed in the generation of steam is in this case very marked and singular. The water will appear to have become condensed on the inner surfaces of the dome, and the vessel containing the water may be entirely emptied by continuing the process. The influence of heat in producing steam is scarcely yet rendered sufficiently intelligible to lead to any opinion more reasonable than that it must be taken away to re-establish those conditions which it had apparently changed. The tendency of heat applied to the bottom of a boiler containing water is to pass through the metal and the mass of water, and out again through the upper surface of the metal into the air. It is curious that the manner in which heat should be conveyed through water is in the form of cellular spheres. Certain particles of water cohere so firmly round an increment of heat and in such order that they effectually prevent its assuming any other form but a spherical one, and this minute ascending globe presenting arches on all sides to the pressures by which it is encompassed rises unhurt through a mass of any quantity. Similar results may be witnessed in cellular globes formed without heat, some of which although presenting a large area to the pressure of the atmosphere, and being only 1-10,000th of an inch in thickness, retain the form of a globe until their contents become decomposed and eventually decompose the substance of which the spheres themselves are formed.

It could be fairly assumed that if any force expanding equally, and in all directions from a point, could be introduced within one of these spheres, unless the elements of the force were liable to decompose the medium within which the expansion occurred, would always retain the form of a globe; but, as a proof of the variable expansion of steam, it may be remarked that heat begins to ascend through water in forms representing the sections of a cone. It is not uncommon to observe innumerable bubbles floating about on the surface of boiling water, some of which retain their shape for several seconds, during which time they have a motion through space of twenty or thirty times their diameters. The cause of this motion is very singular, because it proves that at times heat can disturb a great quantity or weight of water by the simple act of rising through it—whereas, it is commonly supposed that its levity is so great, that it would have no more effect upon the water than a balloon would have upon the atmosphere in ascending through it. When these globules of heat explode, the heat they had contained becomes diffused over a larger area, by taking up new situations in the smaller interstices, between the gases which are above the water line in the boiler. In proportion, as the temperature of the steam space increases, the gases expand, and the interstices between them become diminished in size. Thus the heat is gradually forced within limits which continue to grow less and less until such forces of compression and resistance are reached between it and the water and material of the boiler, that the generation of more steam must be arrested, or the boiler must necessarily give way. When it is considered how great the difference would be in the size of a globule of heat when bound by and liberated from the pressure of the mass through which it has to ascend to become operative as force, It is rather astonishing that a greater number of boiler explosions do not occur.

Yet, probably, there are not many cases where the force of the steam, at the moment of an explosion, has ever nearly approached the measure of the resistance of the boiler, and, as already observed, it is not where the steam has reached any unusual pressure that we are to look for the necessary explosion of boilers. Mr. D. R. Clark, a gentleman who appears to have given some attention to the subject of boiler explosion, stated a few years since when the subject was inviting very serious attention, that the percussive force of the

* Read in Mechanical Section, British Association.

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steam suddenly disengaged from the heated water in a boiler acting against the material of the boiler, could not be adduced in explanation, and as the cause of the peculiar violence of the result of the explosion. Mr. Clark considered that the sudden dispersion and projection of the water in the boiler against the boundary surfaces of the boiler was the cause of this violence, the dispersion being caused by the momentary generation of steam throughout the mass of the water, and its efforts to escape. It was alleged by the same writer that the steam carried the water before it, and that the combined momentum of the steam and the water carried them like shot through and amongst the bounding surfaces, and deformed or shattered them in a manner not to be accounted for by single overpressure, or by simple momentum of steam. This forms one of the more ingenious but illogical explanations offered concerning violent boiler explosions. Whoever has witnessed the ascension of heat through water must have noticed that it is absolutely impossible for a single globule of heat to leave the water line. Nothing but the heat is suffered to get free, and this carries only increase of temperature to the steam space. Moreover, a spherical body can never impart velocity to a liquid. A shot discharged vertically into a vessel containing water will flatten, and in sinking cause a rise at the circumference of the vessel in proportion to the quantity of water it has displaced, whereas if it were true that heat or steam could project water against the inner surfaces of a boiler, the shot should carry a column of water through the vessel that held it. It is probably more obvious that a body not capable of holding water upon its surface cannot project it with force, but rather pushes through it, and suffers the water to subside about it. Thus this cannot reasonably be alleged as a sufficient cause for the occasional violence of the explosion of boilers. But supposing that in the generation of steam the decomposition of water proceeds so far that one of its constituent gases is disengaged, and the other retained, we then reach conditions favourable to this violence. It would perhaps be well worthy of experiment to ascertain how far some preparation capable of rapidly absorbing oxygen would not prevent boiler incrustations, because oxygen is so dense that it may be poured from one vessel to another in the open air, while hydrogen will cause a weighted balloon to ascend. It is probably therefore that they do not operate together in what is called steam power, but that the lighter gas only is set free. If heated hydrogen be brought in contact with air an explosion is inevitable, and this fact may go some way to towards accounting for incipient combustion. If it be admitted also that gases may pass through the material of a boiler it will be then seen that the conditions of explosion are imminent, and only await some electrical motion to set them in force. This is given by the starting of the engine which exhausts the steam space of the boiler, and suffers the air to enter when an explosion results. It would not be devoid of interest to discover if a boiler exploding in this way would give off a momentary flash of light because boiler explosion may represent on a small scale some of the more wonderful phenomena of nature. Thunder follows lightning and precedes a fall of rain, and in boiler explosions we have water producing thunder, and perhaps unseen lightning.

F. M.

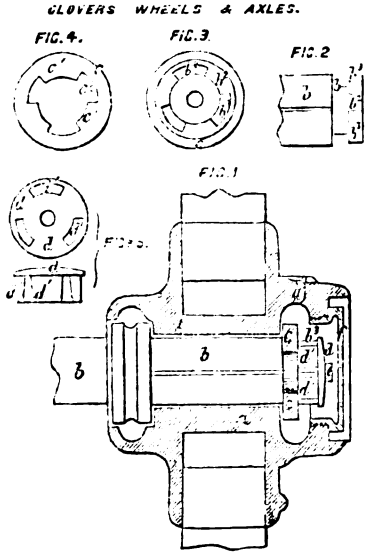
Aerostatic Machine.—M. Couturier, through the agency of Mr. Brooman, of Fleet-street, has introduced to notice what he designates "An improved Aerostatic Machine." It may be used for travelling through the air, or as a toy. It is composed of a hollow body, with extending arms concave below, and with a horizontal tail concave above. It carries a screw when used as a toy. When used for travelling through the air, the body is in the form of a basket for containing the aeronaut; the arms are fixed for a distance from the body and terminate in wings or flappers. Springs are fitted at the connection of the wings and arms, and by means of cords the aeronaut works the flappers, "and may even progress against the wind." When as a toy, the body is in the shape of a bird, and the arms and wings are fixtures; and extending upwards from the body is a rod, which carries a screw movable upon the rod; the air causes the rotation of the screw and carries along the toy. We are not aware that M. Couturier has ventured out in his basket to work the flappers—when he does, our readers will be informed.

The refuse of horn used in the manufacture of combs is used in the manufacture of prussiate of potash, and from the waste in this process is obtained the delicate pine apple flavour used by confectioners.

IMPROVEMENTS IN CARRIAGE WHEELS AND AXLES.

This invention of Benjamin Glover, of Parker's-row, Dockhead, has for its object improvements in the formation of the boss of the wheel in combination with improvements in the construction of the end of the axle, for the purpose of securing the wheels thereon.

In Plate V., fig. 1 shows a vertical section of the boss *a*, of a wheel mounted upon one end of an axle *b*, the parts being constructed and arranged in accordance with the improvements; fig. 2 shows one end of the axle or arm *b*, separately; fig. 3 shows an end view of the axle *b*, with the ring or "collet" *c*, thereon; fig. 4 shows the ring or collet *c*, detached; and figs. 5 and 7 show separate views of the locking plate *d*. The end of the axle *b*, has a circular groove b^1, formed thereon, other grooves or key-ways b_2, being formed at right angles thereto, so as to leave projections b^3, b^3, at the end of the arm *b*. The central opening in the ring or collet *c*, corresponds in form with the end of the axle, so that it can be easily slidden upon it; and when it has passed beyond the projections b^3, it can be turned round, so as to place the internal projections *c*, behind the projections b^3, the grooves or recesses b^2, and c^2, being thus brought opposite to each other into a position to receive the projections d^1, which form part of the locking plate *d*. The several parts so



put together are secured by the central screw pin *e*, being screwed into the end of the axle *b*, the shoulder formed by the collet *c*, serving to retain the wheel securely upon the axle, which is covered by the screw cap *f* screwed into the recesses formed on the outer side of the boss *a*. Oil, for lubricating the axle, is introduced when required, through the orifice *a*1, which at other times is closed by a screw or plug.

The patentee remarks, that in the construction of wheels, according to this invention, for all kinds of road vehicles, no portion of the nave or stock projects beyond the line of the tyre, as is the case in ordinary wheels to the extent of from three inches, and in many cases considerably beyond, frequently causing collisions in passing other vehicles, and rendering wide vehicles almost useless for narrow streets and gate-ways. The ordinary mode of securing the wheel upon the axle by means of a collet or nut and linch pin involves the necessity of having a projecting nave, whereas by these improvements the wheel is secured to the arm by the collet *c*, and locking plate *d*, (without the aid of linch pins), thus greatly reducing the width of the parts, and rendering the projection of the nave beyond the line of the tyre of the wheel unnecessary.

The claim is "for the improved mode of constructing and combining the parts of carriage wheels and their axles, for the purpose of securing the wheels upon the ends of the axles or arms, as described."

M. Jules Gindre reports, in *Les Mondes*, that he has prepared and patented a new manure—a combination of potash and feldspar—which is suitable for all kinds of culture, especially for the vine, and which has been tried with good effect near Bordeaux.

DEEP SEA CABLES, &c.

At the British Association Congress a paper was read on the Sheathing of Deep Sea Cables, by Mr. C. W. Siemens. The paper called attention to the forces which act upon a cable while descending to the bottom, and to certain conditions which have to be fulfilled in order to insure its durability when laid. It was maintained that the spiral, or rather helical, sheathing usually applied to deep sea cables is defective, because it must necessarily elongate and twist round its own axis during its descent, because the iron or steel wires composing the sheathing frequently break and endanger the success of the operation, and because such cables when laid are rapidly destroyed through oxidation of the iron. It was shown that an outer covering of each wire with hemp, while beneficial in reducing the specific gravity of an iron-covered cable, cannot be depended upon for strength, and rather increases the risk of rapid destruction of the cable when laid. The paper proceeded to show that a sheathing composed of two layers of strong hemp under a certain tension bound tightly round by a flexible armour of copper or zinc sheathing is free from the objections previously enumerated, that such a cable actually forms the connecting link between France and Algeria, and has given evidence of permanent success.

Mr. William Hooper read a paper in the same section "On the Applicability of India-rubber as an Insulator for Telegraphic Conductors." In this communication the author first noticed the difficulties encountered in applying caoutchouc for insulating purposes, describing the decay of native chaoutchouc, especially when exposed to air and light, arising from oxidation, and resulting in a condition of fluidity. The components of caoutchouc were stated by the author to be 84·56 carbon, and 12·33 hydrogen, agreeing almost exactly with Dr. Miller's figures in a previous analysis. In applying chaoutchouc as an insulator it has been generally washed, dried, and masticated, being manufactured by the process into solid blocks, which are then cut up into sheets, which are again divided into tapes. After serving the tapes around the wires they have usually been consolidated by heat, or by the use of solvents, both of which are injurious in their tendency to favour oxidation. Wires thus insulated give good results for a short time, but their efficiency is soon destroyed. The results obtained with five specimens of india-rubber covered wire supplied for experimental purposes to the Government of India, and sent out to Kurrachee in 1863, were adduced by the author, and showed that four out of the five were defective after submersion in the Indian Ocean, one only, supplied by himself, remaining perfect. In insulation this specimen was the highest yet attained, and the perfection of the joints was fully proved. The central position of the conductor was unaltered by any elevation of temperature, and its insulation remained good up to 150 deg. Fahrenheit and even higher temperatures. The mechanical properties of the core devised by the author were also shown to surpass all other materials yet produced. The importance of the low inductive capacity of the wires insulated by the author's process was also dwelt upon. Sir Charles Bright, Mr. Latimer Clark, and Professor Thompson had made independent investigations into the capabilities of the wire thus insulated, and the results, deduced by those gentlemen were singularly in accordance with each other, the two former giving the induction of the author's wire compared with gutta percha as 100 to 136, the latter as 100 to 135. The rate of signalling being proportionate to the retardation arising from induction, the value of the process in a line of such length as the Atlantic cable would be at once apparent in a commercial as well as a scientific view.

Professor Thomson assigns to the sun's heat, supposing it to be maintained by the appulse of masses of matter, a limit of 300,000 years; and the period of cooling of the earth from universal fusion to its actual state 98,000,000 years.

Bristol Industrial Exhibition.—A Mr. Perry, of Yeovil, Somerset, exhibits in the Bristol Industrial Exhibition a model of a church, with a peal of bells and miniature ringers, and several small cases containing mechanical figures, railway trains, &c., the whole of which, before they can be set in motion, severally require that a halfpenny shall be dropped into the till. These working models are very attractive, and it is estimated that several pounds are dropped into the tills in the course of the day. There are 11 of these mechanical figures all belonging to the one man.

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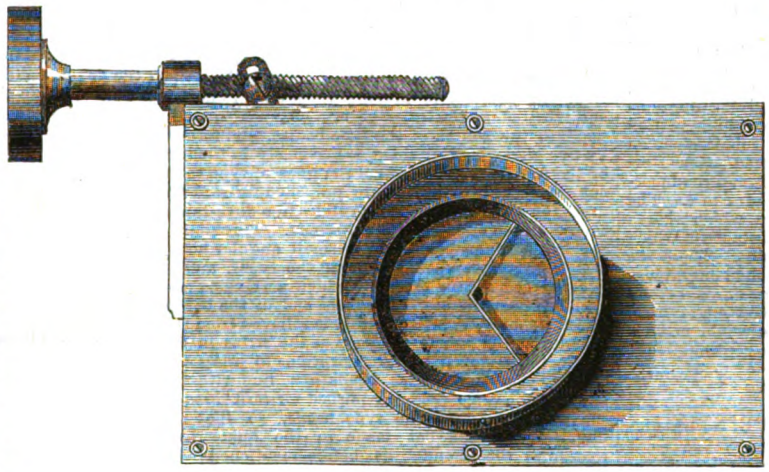
MICROSCOPY.

A Graduating Diaphragm.—A very ingenious diaphragm (says the *Popular Science Review*) has just been devised by Mr. Collins, of Great Titchfield-street. The advantages of the new instrument can only be appreciated by those who understand the necessity which exists for regulating the amount of light which is reflected from the mirror of the microscope upon the object under investigation. In the ordinary "wheel of diaphragms" there are about half a dozen apertures of different sizes, and the observer rotates the disk until he finds an aperture which admits the proper flood of light. There are, however, two serious objections to this method:—1st, As the number of holes is limited, the microscopist, though enabled to select the best aperture of the series for his purpose, may not be supplied with such an aperture as would give the exact absolute degree of illumination. 2nd. While rotating the "wheel" to obtain the required result he loses sight of his object, and thus is unable to perceive fully the advantage he has derived from the alteration. Both these disadvantages have been overcome in Mr. Collins' diaphragm, which provides a means by which any sized aperture may be obtained without removing the object from observation. The subjoined engraving explains the apparatus. It consists of a plate, placed beneath the stage, and having below it two smaller ones, whose opposite sides are incised in a cunneate manner, and which, when separated, leave a large lozenge-shaped aperture; but, when caused to approach, gradually diminish this aperture till it is reduced to a mere point. The agproximation and separation are effected by means of a screw, whose milled head is within easy reach of the observer's finger. This piece of apparatus may easily be appended to any microscope, and the manner in which it aids in the display of the striæ of enamel and muscular fibre, and the delicate markings of the diatomaceæ, must be seen to be fully appreciated. Obviously its greatest merit lies in the power which it gives to the observer of graduating his aperture of illumination with the greatest nicety, and of estimating the improvement in the definition of fine points of structure as he proceeds in his observation. It might appear at first that the lozenge-shaped aperture would interfere where certain varieties of illumination are required: but we think that this objection can only be urged in exceptional instances. For most of the purposes of research the new diaphragm is an immense improvement on the old one.



COLLINS' GRADUATING DIAPHRAGM.

BOOKS ON TURNING.

The subjoined list of works on turning has been made with the intention of sketching a basis on which to found something better in the way of a Manuel of Turning than is yet published. Let everything old in an art be understood, and then a safe onward movement can be effected, seems to be a motto worth adopting. It is hoped that the list will be sufficiently explicit to enable any turner to select the book most suitable to his own purposes. The legion of lathes for simple screw-cutting, and those involving Blanchard's principle, are not noticed. It is hoped, soon, to supplement this with notes upon the German authorities, and the Specifications of Patents since 1855.

1. Schopper; Hartman;—"Panoplia omnium, etc" Frankfort on the Maine, 1548. Contains some illustrations of turning. Holtzapffel, page 6.

2. Besson, Jacques; of Dauphiny, France; "Theatrum instrumentorum et machinarum." Lyons, 1582. Comprises three illustrations of machines for oblique turning, oval vase, and screws upon cones and cylinders. See Plumier, preface, p. 3, and Holtz. p. 5; the latter, on p. 616, gives an illustration of his "kind of lathe, in no part ever before seen, and which is not without ingenuity; for cutting, little by little, screws on any round solid, and even on an oval one."

3. De Caus, Solomon; les raisons des forces mouvantes, 1624; one engraving of a lathe for ovals, no explanation.

4. Moxon; Mechanick Exercises, two vols, London, 1677-83. The first volume contains turning, and gives three or four illustrations, one of a lathe with roves for rose-engine work.

5. Felibien;—Des principes de l'architecture de la sculpture, etc: Paris, 1690; twelve pages, describing a lathe, some oval and rose-engine work.

6. Plumier, Le pere; Minime religieux; l'Art de tourner en perfection. 1 vol., 4to., 60 plates, Lyons, 1701. This is the first work entirely devoted to turning. One of the silent orders of monks showered down blessings on one of their companions who introduced the turning of chalices as a recreation for leisure hours. Plumier is very complete; he has four methods of oval turning—1, by roves or rosettes; 2, by a ring adjustable at any angle upon a vibrating mandrel-frame; 3, by an eccentric in a box, "tambour;" 4, our present oval chuck, but the ring is placed vertically. The good old monk says he obtained the pattern from the Abbé Forcet of Paris. He ascribes other beautiful machines in his book, for ornamenting tool-handles to the English, but not this chuck. Abraham Sharp is said to have invented it. I believe his MSS. are still preserved; why are not the original drawings of this published? James Spackman and James Williamson patented it as theirs, in 1764. Specification No. 821. Plumier's lathes are mostly fancy ones, the swash, pump and rose work, moved both by weights and springs, are amply illustrated. His specimens of spiral and pump-work are extraordinarily fine. His fluting and handle-carving machines very interesting. He concludes his book with some stocks and dies, and screw-boxes. A rest and hook, contrived to hold the tool immovable, would be still useful where no slide-rest is obtainable.

7. Spackman and Williamson's specification of patent for lathe, for elliptical turning, quoted above. This oval chuck has two parallel slots through its back plate, one for each of the two supports to the cheeks which act upon the eccentrized ring.

8. L'Encyclopedie Methodique; Paris, begun in 1782, contains forty plates of turning, mainly after Plumier.

9. Gregory: A Dictionary of Arts and Sciences, London, 1807; contains not much that is interesting; his polishing, oval chuck, and secrets of the art, are copied verbatim from Plumier.

10, Smith, James; The Panorama, Liverpool, 1815; contains a good article on turning, with three admirable illustrations, badly copied into "The Turner's Companion." The oval chuck, (or elliptical, as he correctly terms it) is well drawn and explained. It contains a very primitive slide rest (anterior to Maudslay's?) and refers to one used by Earl Stanhope in his stereotyping machinery. Healy's chuck for cutting screws is also given.

11. Bergeron L. E.; Manuel de Tourneur: 2 vols., and Atlas, Roret, Paris, 1816. This work contains almost everything the most fastidious taste can demand. Lathes with long mandrels and screws cut on their shanks are the most common. The drawings of tools are most exact; screw cutting is fully treated of, flute making well described, and in spiral, spherical, and fancy turning, everything is given which can be desired. A fluting machine, epicycloidal chuck, eccentric do., swash mandrel, pump mandrel, rose engines (both by the tool vibrating, and the mandrel-frame), straight line chucks, medallion engine, flying cutter, &c., furnish quite a feast to a mind mechanically inclined. Some of these apparatus have been vastly improved upon, first of all by Holtzapffel of London, and secondly, by Kennan of Dublin, but we have no descriptions of their machines in existence.

12. Perkins, Jacob; Specification of Patent: No. 4,400, A.D., 1819. An engine lathe for engraving surfaces, &c. This is a machine for cutting lines, generated by the action of a compound eccentric, oval, and epicycloidal action, set vibrating in a mandrel-frame, moved by an eccentric above the mandrel. There are no illustrations of the figures it would describe, but the drawing is very explicit. Plate 2 fully illustrates the former machine applied to work on the surfaces of cylinders. Four other plates have nothing to do with turning.

13. Ree's Cyclopædia, London, 1819. Under turning, lathe and rose-engine are given the best description of general work. His illustrations are Maudslay's last bar lathe with its slide-rest and gearing for screw-cutting, Holtzapffel and Deyerlin's rose-engine, with a good selection of chucks, including an eccentric and oval one.

14. Rich, C. H., Southampton, 1819. Specimens of the art of ornamental turning in eccentric and concentric patterns. Six copper-plate engravings (this I have not seen).

15. Gregory's Mechanics, 2 vols; London, plates by Farey, London, c. 1820. A good drawing and description of Maudslay's lathe when he lived in Margaret-street, Cavendish-sqaure. It is a bar lathe, has a dividing plate and adjustable crank-hook, as in Smith's drawing, and a vice-chuck. The slide-rest has in addition to the three usual motions another vertical one, obtained by a screw and four diagonal slots on the vertical sides of one of the foundation plates at its base. The sketch of it is most distinct, and shows the straits he was driven to in being obliged to build up his slide-rest mainly of wrought iron.

16. Whitworth's, Jos. Specifications; No. 7441, A.D. 1837. The first part and plate describe his method of driving a face-plate, by friction-rollers on its back.

17. Ibbetson, J. H. Third edition of his eccentric turning, with additions and descriptions of his compound eccentric chuck; London, 1838. This is a very prolix and peculiar description of a good double eccentric chuck, the screws of which have centre-screws acting on their extremities to keep them from end-play. The book is very dear, and its contents are to be found in Valicourt.

18. Stivens, Alex.; Specification No. 8707, A.D. 1840. One shape of the scroll-chuck given in this is identical with the one in Bergeron, pl. 33. The other is worked by a mechanism slightly different, both are three-jawed chucks.

19. Supplement à tous les ouvrages sur l'art du Tourneur. Library Roret, Paris, 1848; includes Ibbetson's work, Clement's lathe from the transactions of the Society of Arts for 1827; Whitworth's lathe; Scot and Sinclair's, and many well-written articles from French mechanical periodicals.

20. Findlay, Joseph; Specification No. 13,030, A.D. 1850. A lathe for turning bobbins, self-acting, and having a screw cut right hand at one end, and left-hand at the other to advance the front and back tools simultaneously.

21. Handbook of Turning. Saunders and Ottley, London, c. 1850. A small volume peculiarly written, much of it from No. 10. The illustrations, where they are correct copies, are indifferent, and where any variation is attempted the result is detestable, every circle, in perspective, becoming an oval with sharp angles, and some of the cylinders showing both their ends at once. The descriptions of eccentric work, goneometer, universal cutter, and drill are tolerably good, but the illustrations are incorrect and badly executed.

22. A Concise Treatise on Eccentric Turning, by an amateur; published by Pelham Richardson, Cornhill, London, 1852. The most beautiful specimens of eccentric turning ably described, and well illustrated. The prefatory remarks on this and drilled or "lace" patterns, are valuable.

23. Muir, Wm.; Specification No. 1410, A.D. 1853. Lathe for driving a face-plate by a pinion acting on internal cogs at its back; a system of supporting

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screws and yet allowing a nut to pass by; and a method of opening the nut of the leading screw and simultaneously throwing the backing mechanism into gear.

24. Journet, Pierre; Specification 1268, A.D. 1854. A nothing in the form of a jaw-chuck.

25. The Turner's Companion; published by Henry C. Baird, Philadelphia, 1856. The same book as 21, with the same naive illustrations.

26. Ash, Captain Jas.; Inventor of the elliptical cutter frame; Double-counting on the lathe. London, L. Booth, 1857. A cleverly written and well illustrated treatise on fancy turning. The designs seem far too difficult for such simple machinery as that by which they were really effected, and the conciseness of the directions affords a beautiful contrast to the wordy and egotistic writing of some of our would-be masters in turning. This gentleman's cutter is a wonderful example of making a small and easily managed tool do the work of the cumbrous epicycloidal and other chucks and ponderous apparatus of the last century.

27. Valicourt, E. de; Nouveau manuel complet du Tourneur, Paris, Librairie encyclopedique de Roret, 12, Rue Hautefeuille, 1858, 2 vols., plates, and atlas. It is an extension of M. Dessables' Manuel, including all 19, Fox's lathe, with much of the best portions of Desarmeaux and Holtzapffel. Two of the lathes in it on plate 7, by M. Sevin-Talive, appear to be mistakes. Nearly all the rest of this very complete work are well described and illustrated.

28. Campin, Francis; The practice of Hand Turning; Spon, Bucklersbury, London, 1861. A cursory view of the art and many of its adjuncts, inserting much that is useless, and giving no information on intricate points in turning. The portion upon change-wheels is peculiar, the rule is given on one page and the sole example thirteen pages afterwards, then it is roughly calculated, and the incorrect ratio, 178 to 73, given instead of 7 to 4. The book has many unnecessary clauses which sketch out the author's intention and the substance of which he has to repeat in the next sentence. There are also some peculiar examples of slip-shod engraving, yet there are many redeeming features. A careful compilation from standard works, good engravings, and an abundance of practical hints would make a book worthy of being reckoned as the continuation of Holtzapffel's great work. H. H.

THE MANUFACTURE OF PRINTING TYPES.

Mr. J. J. C. Smith, of Philadelphia, has patented, through Mr. Newton, of 66, Chancery-lane, certain improvements in the manufacture of printing types, which we purpose this week to describe. The object of the invention is to make types from harder materials than those cast from the well-known type metal. This is effected by cutting the type with a machine adapted to the purpose from strips of metal, each having a row of type heads on one edge, which heads are made of copper by the electrotype process, the following being the mode of proceeding:—

A complete fount of type is set up in rows, with a blank intervening between each type equal in thickness to a saw cut; between the first row of type set up in the manner described, and the next row, a ruler is placed, the top edge of which is about one-eighth of an inch below the faces of the type heads. In this manner a "forme" of sufficient size is produced, and from it moulds are taken to be used in electrotyping the heads. As soon as the electrotyped plates produced in such a mould are of the required thickness they are removed from the moulds, and the cavities on the reverse of the plates are filled with soft solder or tin. The electrotyped plate of type heads is then cut into strips, each strip forming a connected row of type heads of copper, by means of a machine, which consists of a table fitted with an adjustable guide bar, and with a circular saw that projects up through the table. To the side of the fixed guide bar a shorter guide bar is pivoted, so that its free end may be raised or lowered, as desired. Permanently secured to a projection of the pivoted bar is a plate which forms the actual guide for the plate to be sawn, as it stands in exact line with the saw, and in front of it. The saw and guide plate are each of the same thickness as that of each of the spaces between the rows of type heads in the plate to be sawn. When the sawing operation is to be performed, the pivoted bar is raised, and the plate of type heads is placed under the guide plate, which, fitting to the spaces between the rows of type heads adjusts the electrotyped plate in exact line with the saw. The plate is fed up by hand.

The type bodies may be made in several ways, one of which consists in casting a strip of type metal on to each of the rows of type heads above described. In casting the bodies a mould may be conveniently used, consisting of two cast-iron bars, each about 15 inches long, and 2½ inches wide, and connected by a hinge in such a manner that they may be closed on each other as the jaws of a clamp, or opened at will. A strip of brass or steel is fastened to the inner face of one bar, and in thickness equal to the desired thickness of the type bodies intended to be cast. The jaws of the mould are grooved longitudinally to receive a bar of cast-iron with a longitudinal groove on a middle line along one side thereof, the groove being about one-eighth of an inch in depth, and in width equal to the desired width of the type intended to be produced. In the groove of this bar a row of the above-described type heads is laid face downwards, and the bar is then placed in the clamp or mould, which, when closed, is filled with melted type metal, that unites with the row of type heads. These strips are afterwards cut up into single types by means of a cutting machine.

Another way of making the type bodies consists in soldering strips of rolled metal to the rows of type heads, which strips are cut up into single types by means of the cutting machine to be now described. This machine consists of a bed-plate with two V-shaped grooves, on which a sliding carriage is mounted for the purpose of bringing the strips to be cut under the action of a circular saw, and after each complete cut, withdrawing the strips from the saw before moving them up for another cut. Fitted on the carriage is a channel equal in depth to the height of the type bodies, and formed by two guide bars, divided transversely in the line of the saw. In this channel the lines of type to be cut are placed, and they are propelled forward by means of a sliding bar, which slides in a dove-tailed groove on top of one of the guide bars. This sliding bar has a hinge joint, and a small angular hook, which enters the spaces between the types, and it is connected with a lever, by which a traverse motion is given thereto. The loose end of the bar is raised by a spring when the bar is relieved from the pressure of the lever. As soon as the strips in the channel are moved so far forward as to bring the spaces between the type heads in a line with the saw, a transverse finger is pushed forward through the spaces between the type heads, so that the finger enters the cut made in the guide bars that form the channel, as before mentioned; by this means the type heads are accurately adjusted in the position necessary for them to hold while the type are being cut off. A block which moves in the box that guides the finger projects about half-an-inch beyond each end of the box, and is connected with a lever having its fulcrum on the carriage. This block acts as a grappling jaw, and serves to hold the strips, and the type being cut therefrom, firmly in their true positions while the cutting operation is going on. As soon as the person operating the machine has closed the gripping jaw he withdraws the gauge-finger and moves the carriage up to the saw, the rotation of which severs the end types from the strips. These loose types are kept in position when released from the gripping jaw by a block of metal, which fits into and is capable of being moved along the channel by the feed motion before described.

In justice to ourselves we must add that we have not seen any of the types constructed on the above method, but we do not see why some such plan should not be found of use in the larger "founts" of types in everyday use; for it is well known that, with the present types, all that fall on the floor of an office are damaged, if not totally destroyed.

FACTORIES—THE EMPLOYMENT OF YOUTH IN THEM.

The Commissioners appointed to inquire into the employment of children and young persons in trades and manufactures not regulated by law—that is, for which the provisions of the Factory Act have not yet been made operative—have just issued a fourth report, which is of a most interesting description. The trades and occupations which have been lately investigated by the Commissioners are principally connected with the metal industries of Yorkshire, London, and South Wales; but various other trades have been carefully examined into. On each of them a separate report has been made, and with it is printed the detailed testimony upon which the deductions and recommendations of the reporters are founded. These subsidiary reports are summarised in a long general report, from which we extract some of the leading points.

The first subject treated of is the metal manufactures of the Sheffield district. This report is by Mr. J. E. White, and in it is pointed out the conditions under which the grinding trade is carried on in Sheffield. The occupation is terribly destructive of life, from the liability of the worker to inhale dust, the necessity of a constrained position while at work, and the ill-ventilated state of the workplaces, which "must be seen to be appreciated." In 1860 Dr. Greenhow found that the death rate among these men had an annual average of thirteen in the thousand, which is more than double that prevailing in rural areas. This inhalation of dust, metallic, or arising from stone, bone, ivory, and other materials, prevokes pulmonary diseases. Dr. Hall also in 1857 reported of the fork-grinders, that he found them exposed to influences which had a tendency to rob them of twenty-five years of their lives, and so fill the union houses with widows and orphans. (It will be perceived here how the general public have to pay for the effect of selfishness on the part of the few employers.) And now Mr. White, in 1865, shows that the same causes of excessive disease are in operation, with the same fatal results. The average age to which the men live is 36 years, but some so long as 42. These are the horrible conditions under which the employment of children and young persons have to be considered. The children are put to the work at 10 years old, and sometimes younger—some so young as 8 or 7. Mr. White found one 6 years old, who had been working for some months with his father. The employment in which most of the young children are found is cutlery. Girls and boys begin in this at 6 and 7 years old. One was found who had begun at 5. The following terrible fact is recorded by Mr. White: "In most cases the youngest children are employed by their own parents and relations—often in consequence of the intemperate or improvident habits of their parents;" and the long hours during which these children are made to work are, say the reports, "not only cruelly, but even incredibly long." They are worked by day and night turns; excessive overtime is thrown upon them—sometimes a quarter of a day, a half, even a whole period of twelve hours in the twenty-four. A boy nine years old, or at most ten, worked at crine-line steel-rolling three nights running as well as the days, and this under his own father. "We should have gone so to the end of the week, only the engine broke down." A great number of instances as hard, and nearly as hard, as this are quoted. The boys are often subjected to heavy work. "I have seen a boy fourteen years old using a 22lb. hammer in file forging, and some who have grown completely out of form from the work." Mr. White remarks bitterly, in reference to these cases: "No wonder that boys sometimes fall asleep at their work, stumble, fall when the metal flooring gets 'hot and slippy,' and work is pressing, get burned or pierced with red hot iron or steel, or otherwise suffer for their supposed negligence." The boys grow up, if they live, stunted and weakly, sometimes deformed. They are fearfully ignorant.

Here legislation most assuredly is required; and to it it will undoubtedly be shortly directed.

The report on the foundries and machine shops in Leeds and the West Riding is by Mr. F. D. Longe, and he states that the boys go to work generally at about thirteen years of age, but some between eleven and twelve. The great evil is the system of "overtime." The same was found to be the case in iron shipbuilding yards and engineers' works. In the letter-foundries of London, though the working hours are long, yet the conditions of juvenile labour are not unfavourable. The report upon the hand-loom carpet weavers does not require particular notice, but that upon "heald knitting" is remarkable. Few people other than those in some Lancashire villages know what "heald knitting" is. "A heald is an open knitted framework made of cotton, and fitted to looms to raise the threads of the work in the process of weaving." They are still made by hand, and in cottages children begin to aid in the work when five, six, or seven years old, and they "work fourteen hours a day as a regular thing." "I used often to go to sleep at the work"—the boy was thirteen, and had worked from six years of age fourteen hours daily—"then the knitter would hit me to wake me up." And one effect of these long hours and the nature of the work the children are put to, which is to reach over the frame as far as they can, tends to deform them. One shoulder becomes raised and the back crooked: the legs get bent. They are paid 1s. 3d. a week for this. They are deplorably ignorant. The commissioners recommend the application of legislative action in this case. An interposition of the law is recommended with

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the manufacturers of umbrella and parasol handles in the neighbourhood of Stroud; and the makers of bobbins and spindles, to which trade children are brought very young, They experience from the flying dust, with which the atmosphere of the workshop is laden, many of the evils which the Sheffield grinders suffer, and the rate of mortality is driven to a shockingly high degree. In the india-rubber manufacture the principle grievance is long hours.

The manufactures of paper and of glass are also treated on. In the first named, of the total number employed about half are females, and of these one-fourth are under eighteen years of age, while one in six is under thirteen. This will give the total number of females engaged at 500,000, about 2,000 of whom are under thirteen and 10,000 between that age and eighteen. There are about 500 boys under thirteen and 10,000 youths between thirteen and eighteen thus occupied. The report shows that it is desirable the trade should be placed under the Factory Acts' Extension Act. In respect of the glass manufacture the commissioners consider that females should not be employed in any process of manufacture in a glass house; nor boys under the age of twelve, after which age till they are eighteen the hours of work should be apportioned on a proper scale to their years. Boys and youths below the age of sixteen should be allowed a certain number of hours weekly for schooling according to the rule of the Factory Acts.

Much unfortunately, very much more, could be extracted of equally interesting matter; but our space will not permit. Enough, however, has been printed to show that the matter is one demanding legislative interference.

RANDOM NOTES.

The quantity of hemp and other vegetable substances of the nature of undressed hemp imported from the East Indies and the Philippines, was in 1851, 589,460 cwt., and in 1864, 2,306,752 cwt.

Wakefield Industrial Exhibition.—This exhibition is one of the most successful yet entered upon. Day after day flocks of eager sightseers crowd the building. It is a thoroughly well got up exhibition, and we wish it success to the end.

Mr. Carey Lev, of Philadelphia, finds that ozone checks the growth of the roots of plants. The ozone he used was generated by the action of sulphuric acid on Chameleon mineral.

A small lead shot weighing ·072 gramme was found to cause 192 times its own volume of air to penetrate beneath the surface of water by being thrown into it from a height of 1½ feet at an angle of 60 deg.

Messrs. St. Claire, Deville, and Troost have invented a pyrometer capable of measuring a temperature reaching as high as 1530 deg. C. At this heat the inventors state copper and silver are vaporised, and feldspar perfectly fused.

Paper pipes, 6 inches in diameter, are used in the Pewabic copper mine to convey air from one portion of the mine to the other. They are 6 inch inside diameter, are quite strong, and can be joined perfectly air-tight by a strip of canvass and a coating of tar.

One good Havannah cigar is found by Dr. Richardson to yield, when its smoke is condensed, a sufficient amount of poisonous matter to induce active convulsions in a rabbit, and six pipes of common shag tobacco will yield sufficient poison to destroy a rabbit in three minutes.

The Rev. W. R. Dawes concludes that the ruddy tint of the planet Mars does not arise from any peculiarity of the colour of its atmosphere, as the redness is most apparent in the centre where the atmosphere is thinnest, and it is suggested that it arises from the colour of the soil.

A piece of crown or heavy flint glass, through which a discharge from a large Rhumkorff coil is passed, undergoes a permanent molecular modification in its whole extent, losing almost entirely its rotary magnetic power, and acquiring the properties of a crystalline body, or glass suddenly cooled.

The best coal is put on board at Newcastle for 9s. per ton; before it reaches the consumer in London it is at least doubled in price; before it reaches France it is about trebled; in the Mediterranean ports it is quadrupled; while in many remote parts of the world coal cannot be purchased for less than £3 or £3 10s. per ton.

In consequence of official orders to that effect, all the French railways shall be compelled to adopt appliances for instantaneous communication between every part of a train at the end of the present year.

PHOSPHORESCENCE IN CONNECTION WITH STORMS AND DISEASE.

A valuable, though almost necessarily incomplete, paper on this highly interesting subject was read in Section D of the British Association Congress by Dr. Moffatt, and which provoked a long and interesting discussion. The doctor stated that the subject had been under his consideration for some time, and that his opinions had been deduced from observations extending over a period of four years. He exhibited tables to show that the atmospheric conditions under which the luminosity of phosphorus took place were those of the south or equatorial current of air, namely, a minimum of atmospheric pressure and maximum of temperature and humidity; and that those under which non-luminosity takes place are the conditions of the north or polar current, namely, maximum of pressure and minimum of temperature and humidity. The atmospheric conditions of ozone and no ozone periods were the same as those of the luminosity and non-luminosity of phosphorus. Phosphorus became luminous and ozone periods commenced on the approach of storms, and if a storm set in during a luminous or ozone period, the luminosity increased in brilliancy and the ozone in quantity. Of diseases 80 per cent. of apoplexy, epilepsy, and sudden death occurred on the days on which phosphorus became luminous. The atmospheric conditions which led to those storms, of which the telegram gave them warning, were invariably accompanied by diseases of the nervous, vascular, and muscular systems. In conclusion, Dr. Moffatt asked whether, seeing the intimate connection there was between periods of the luminosity of phosphorus and ozone periods, and of non-luminosity and non-ozone periods, and knowing that ozone is formed by the action of phosphorus on moist air, they might not reasonably look to phosphorescence for the chief source of atmospheric ozone?

THE TOY AND JEWELLERY TRADE.

In the section devoted to economic science at the recent meeting of the British Association, Mr. Wright read a paper on jewellery and the gilt toy trade, in the course of which he traced the rise and progress of the trade in Birmingham, and remarked upon the social habits of the workmen employed in the trade as affected by their peculiar occupation. Mr. Wright stated that it was a fact, though in all probability the shopkeepers in London would not admit it, that more than one-half of the articles of jewellery in the shops between the Bank and Hyde Park in London were manufactured in Birmingham. A great improvement in the taste and skill displayed in the manufacture of jewellery had taken place within the last few years, and this was ascribed to the fact of a school of art existing in Birmingham, and an attendance at which was required by masters of their apprentices. The number of persons employed in the trade was set down at not less than 20,000. A great deal of the prosperity of Birmingham during the past few years, not alone to the jewellery trade, was ascribed to the working of the patent laws. Sir John Bowring remarked upon the question suggested by the paper—the influence of schools of art not only upon manufactures, but upon public taste—a question of great importance. He thought in this respect the public were much indebted to Birmingham, and so do we.

Mr. Donald M'Kay's Torpedoes.—The sailing frigate Terpsichore, 18, which has been selected by the Admiralty to be handed over to Mr. Donald M'Kay, of Boston, United States, to be used by him in the experiments about to be undertaken for the purpose of showing the value of torpedoes as an agency for destroying vessels of war, is now alongside the dockyard at Chatham. She has been denuded of the whole of her stores and gear, so as to leave her an empty shell, in readiness for being moored at the end of the harbour, where the trials are to take place, care being taken to place the vessel at such a spot that accidents may be avoided. To test the value of the torpedoes, 30 of them will be placed under the frigate and discharged, these consisting of six large and 24 smaller shells, which are now in course of manufacture for the purpose. The test shell will be planted in the mud, below the vessel's keel, 48 hours before explodimg. Eighteen of the smaller torpedoes will be charged with 60lb. of powder, six with 75lb. each; the six large torpedoes will be charged with 460lb. weight of gunpowder, the whole being sufficient to destroy the largest iron-clad ship in the English navy. The powder for the torpedoes is the same as that in use for the ordinary rifle.

PATENT LIST.

(From the Commissioner's of Patents' Journal.)

LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 23RD SEPTEMBER, 1865.

2687. Electric printing for telegraphic and other purposes, J. H. Simpson—10d.
2688. Machine for manufacturing fish-hooks, C. O. Crosby—2s.
2689. Fitting and mounting chamber utensils, B. Scale—8d.
2690. Lamps for burning magnesium, &c., J. Solomon and A. G. Grant—1s 4d.
2691. Warming and cooling railway carriages, G. Davis—4d.
2692. Expressing fluids, J. M. Rowan—4d.
2693. Distributing liquid manure and sowing seed, N. F. Andreasen—4d.
2694. Mixing and kneading dough, &c., E. Edwards—10d.
2695. Re-burning animal charcoal, J. F. Brinjes—10d.
2696. Fire-places, P. L. Charon—4d.
2697. Stringing and tuning pianofortes, &c., W. Moody—4d.
2698. Axles, W. E. Gedge—4d.
2699. Steam engines, &c., T. Ivory—1s. 4d.
2700. Preventing the extinction of lamps, &c., P. A. Roger—8d.
2701. Applying wheels and axles, W. Rice—10d.
2702. Lighting rooms and buildings, L Schwartz—10d.
2703. Buttons, W. Aston—8d.
2704. Tanning leather, W. Smith—10d.
2705. Clothing for horses, cattle, &c., R. Richardson—8d
2706. Preparing writing paper, J. Forster, and H. Draper—4d.
2707. Hydraulic presses, G. Ashcroft—4d.
2708. Combining railway wheels and axles, J. Furnevall, and G. Keighley—4d.
2709. Manufacture of wadding and waterproof fabrics, E. Pilkington—10d.
2710. Signals for railway carriages, R. C. Robinson—4d.
2711. Steam or other engines, J. Drury—8d.
2712. Signalling on railway trains, F. J. Scott—4d.
2713. Signalling in railway carriages, J. Walker—4d.
2714. Casting steel, E. L. S. Benzon—1s.
2715. Cutting or drilling metallic or other substances, C. W. Wardle, and R. McIntyre—1s. 4d.
2716. Cutting corks, bungs, wads, &c., W. Davies, and G. Cate—10d.
2717. Photographic process, T. Fox—4d.
2718. Thrashing machines, S. Davies—4d.
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CORRECTION OF SEXTANTS.

We understand that an apparatus will shortly be added to the Kew Observatory for the important object of the ready verification of sextants; the system of distant mirrors now in use, designed by Mr. Galton and erected at his own cost, being only available in steady sunshine. The new apparatus has been designed by Mr. Thomas Cooke, the well-known optician. In principle, it consists of four collimators fixed radially, at various angles apart, round the table on which the sextant is to be laid for examination. The cross wires of the collimators in each of their combinations are to be brought successively into contact by the sextant. Then a comparison of its readings with the constant angles of construction of the apparatus determines the error of the sextant at various points of its arc. However, in practice, to avoid the cost of very large collimators, whose object-glass would suffice to include the rays proceeding both to the index and to the horizon glasses of large sextants, Mr. Cooke employs double collimators of moderate size; and he adjusts each pair to strict parallelism, by aid of a detached telescope. The coloured shades of the sextant are readily examined, by strongly illuminating the fields of two of the collimators, after contact of their cross wires has been made in the ordinary manner. On the application of Mr. Galton, backed by the recommendation of the Kew Committee, the Council of the Royal Society has allotted £80 from the Government grant, to defray the estimated cost of Mr. Cooke's apparatus, and its establishment in the Observatory at Kew. The apparatus will be erected in the basement-hall of the Observatory; and when the arrangement is complete it is hoped that the Observatory will become a place where quadrants and sextants can be verified with great facility, and where scientific travellers or officers of Her Majesty's Service may receive instruction in the use of geographical instruments.

M. R. Luther, the director of the observatory at Bilk, near Dusseldorf, has announced his discovery of a new minor planet, of the tenth magnitude, and the eighty-fourth of the series.

The Portuguese Exhibition.—The Portuguese International Exhibition was opened at Oporto on Sept. 18th with great rejoicings.

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NOTES ON PHOTOGRAPHY.

Collodio-Chloride of Silver.—The editor of the *American Journal of Photography* says:—"Mr. Simpson's collodio-chloride process is turning out to be a great success. We have reports from various quarters, that it has been adopted into everyday use. So far as we are informed, all those who have tried it for opalotypes find it far more simple and certain than the processes which have hitherto been used in their production. The collodio-chloride seems to us one of the most important improvements in our art which has been made for a long time."

Carbon Prints.—Among the photographs exhibited at the last *soiree* of the British Association in Birmingham were some carbon prints by Mr. Swan which struck us as the finest we have seen anywhere.

Obernetter's Enamel Process.—The enamels by Obernetter's process exhibited at the *soiree* in Birmingham very much resembled those by Camarsac. Mr. Dale, a member of the firm which has purchased the process, describes it briefly as follows:—A plate of glass is coated with a mixture of gelatine, glycerine, grape sugar, and bichromate of ammonia, and then exposed under a transparent positive. The light hardens the portions upon which it acts, and leaves the rest tacky. The colour, consisting of a vitreous powder mixed with soap-powder, is then applied to the surface, to which it adheres in due gradation. So far the process does not appear to differ materially from that of M. Joubert. Instead, however, of being burnt in at once, the print is now transferred to a convex enamel plate. To effect this the picture is coated with collodion: the film of collodion being lifted up brings with it the picture, which is then placed on the enamel plate. The collodion is next removed by dissolving with ether, as it would interfere with the process of burning. The picture is then placed in the muffle and burnt in the usual manner.

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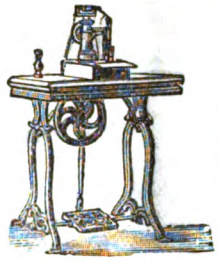

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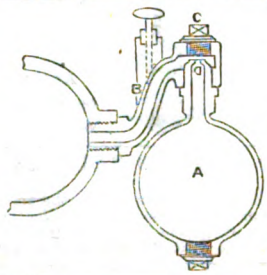

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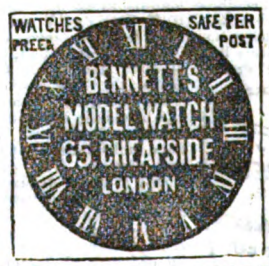

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References and estimates given on application to the Manufacturer and Patentee, A. M. PERKINS, 6, Seaford-street, Regent's-square, London, W.C.

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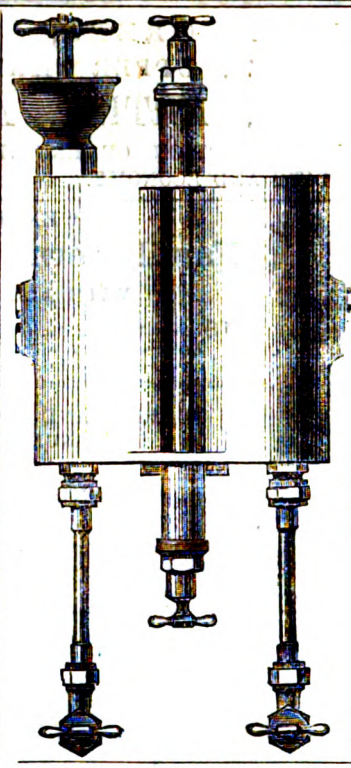

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This Lubricator offers a perfect method of lubricating all the internal parts of the steam-engine, by the vaporisation of the lubricant, saving, at least, half of the oil or tallow generally used, and lessening the "wear and tear" consequent upon imperfect lubrication.

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As they are fixed on the steam-pipe, the diameter of this should be given; and it should also be stated whether horizontal or vertical.

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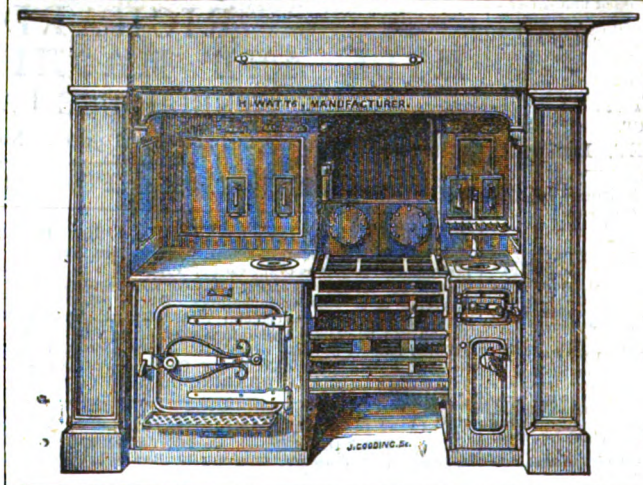

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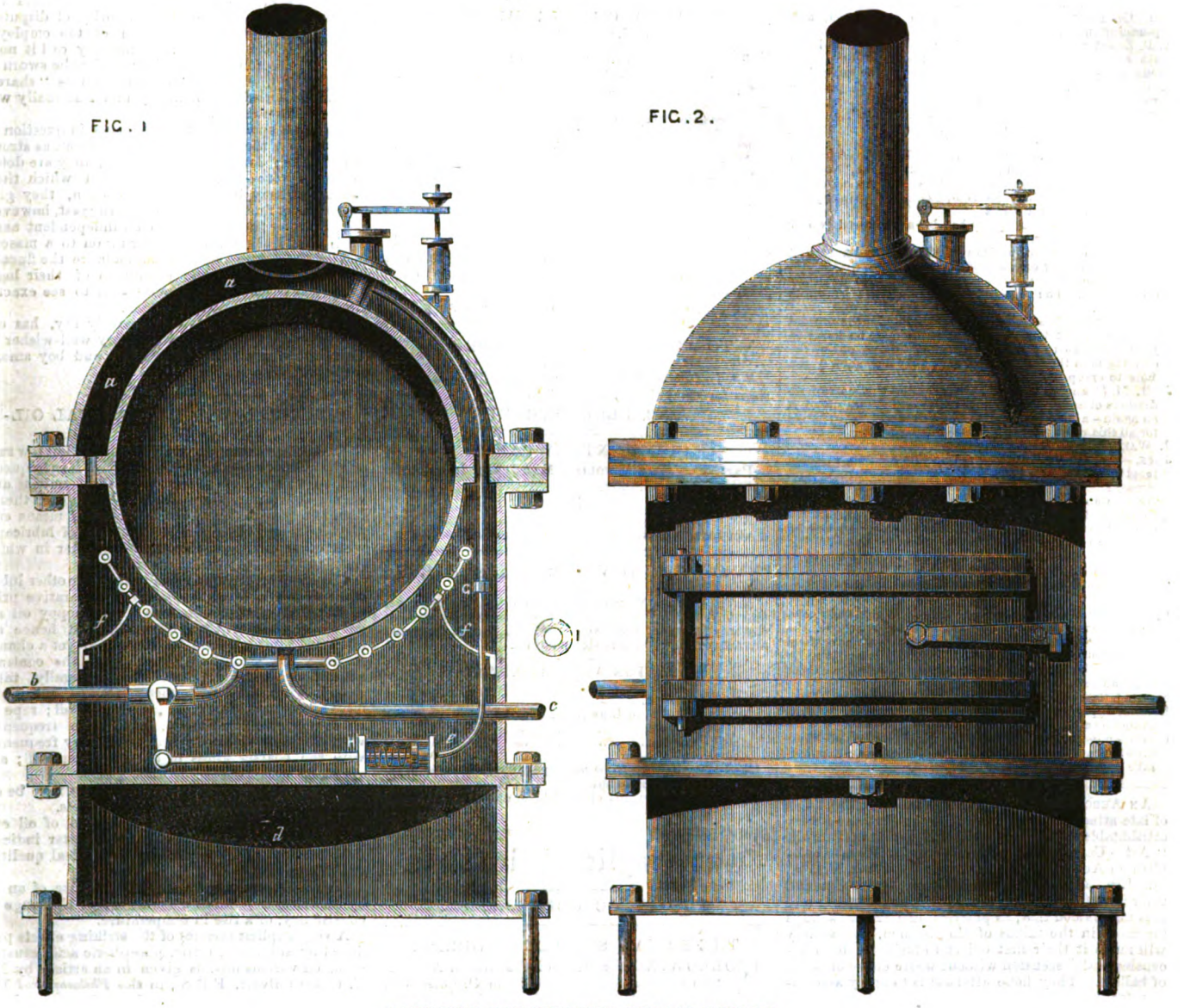
THE

ENGLISH MECHANIC:

A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

VOL. II.—No. 29] FRIDAY, OCTOBER 13, 1865. [PRICE ONE PENNY.



SADLER'S GAS HEATED STEAM BOILER.

We this week make room for a little gas-heated boiler, the invention of Mr. P. H. Sadler, draughtsman, of 4, Richmond-place, Richmond-road, Dalston. It is one of a numerous variety, but has some points which will recommend it to those using model-sized engines, and for amateur experiments. It will be observed that there is attached a simple apparatus for preventing steam rising above a certain point, thereby effecting a saving in the gas. This consists of a small cylinder fitted with a piston and a rod communicating with the gas supply, the piston being kept in its place by a spiral spring, the power of which is regulated according to the desired pressure.

This form of boiler is the strongest, being a perfect sphere in two halves, and having an outer covering forming a chamber for the heated air passing from the under portion of the boiler. This is effected by having holes made in the two middle flanges.

Fig 1 is a section of the boiler; b is the gas supply; c, the feed pipe, which being at the bottom of the boiler serves as the blow-off pipe also; e, is the cylinder for regulating the pressure; d, is the tank; f, f, are brackets for supporting the gaspipes; g, is a screwed joint to enable the boiler to be cleansed; a, a, chamber for hot air. Fig 2 is an elevation of the boiler, showing its real appearance, which when this is studied the boiler can be turned in the lathe after being properly worked on the anvil. This is impossible where plates and rivets are used.

Mr. Sadler in his communication expresses the hope that his "modification" will be acceptable to our readers.

THE value of water-tight compartments in steamers was well illustrated in the case of a collision on Lake Huron, one of the unfortunate vessels having been taken into port sixty miles or more from the scene of the accident, an unsightly wreck forward, great plates of iron hanging by shreds, bent, twisted, and torn, but the joints of her first partition tight as a steam boiler.

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ANSWERS TO CORRESPONDENTS.

ELECTRICITY.

To Our Readers.—In answer to "J. H. S.," "Walter Harrington," and others, it is not our wish to stop "all correspondence on electricity." It is our intention to give a fair space to letters and articles from the pens of telegraphists and electricians, but for the sake of such of our readers whose pursuits are purely engineering and mechanical, we feel bound to avoid filling the columns of The English Mechanic weekly with mere repetitions of questions and answers. We shall, next week, give a full description of Winter's electrical machine, accompanied by engravings.

Ein Uhrmacher.—Griffiths, Clerkenwell-green. Other chemists may keep it on sale.

Several Mechanics.—Let one of you go to the office of the examiner, London-bridge (the local Marine Office), and everything may be learnt there; or a letter to the Secretary, Marine Department, Board of Trade, Whitehall, will do. Spon publishes a "Guide" at 3s.

Sam. Goodwin.—Try point heating to cherry red, and plunging in *oil*.

A. B. Z.—It no longer exists. You will readily find the other by overhauling your back numbers.

Isometric.—In preparation, and will shortly be noticed.

J. C. (Paisley).—Accept our thanks: you will perceive your kind answer has been anticipated.

Young Mechanic.—See answer by "John Swift."

Wm. Slater.—The matter is closed.

——.—See answer to "Isometric."

J. Brown (Reading).—Bennet's book (238 Spon's catalogue), 3s. 6d., might suit you; Boyer's book, 1s. 6d., No. 249, same catalogue; Browning's, 259, 1s. 6d. An advanced work is that by T. L. Donaldson, 292, £3 3s. Get Spon's catalogue, and there select.

Ingho.—We think your query has been answered two or three times already.

Alpha.—Both of your queries you will often find answered in the advertising columns of the daily press.

Aaron Lloyd.—See "Notes and Queries." No necessity for apology. The books recommended are generally asked for.

Thomas Gray.—We are sorry to say that under the present law the patent has lapsed. There can be no harm in your going up to the office, and questioning one of the obliging men there on the matter; they may show you a hole to creep in by.

J. H. M. (Manchester).—We are sorry, but that correspondence is closed. We did not receive the other. Send it on again—as brief as possible—and in it will go. Thanks for all this remainder, which see.

J. Wakefield.—Thanks for your letter.

Jock.—You have been answered in this column, at some length. Why call your intelligent class "scurvy and greasy?" We have never found it so, rather t'other—from "Canongaills to Pleasaunce," and from "Holyrood to Rest-and-be-thankfu'." So, Jock Forbes, if you can get your hours shortened, without doing any one injury, do so; with our best wishes. We may just add that we have yet to make the acquaintance of "the combination" of which we are afraid.

G. C. Gooch.—Register it, yourself, at the Patent Office.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

An Aerostatic Society.—So much interest has of late attached to the subject of aerostation—partly attributable to the publication of Mr. Hatton Turnor's "Astro Castro"—that it is in contemplation to establish an Aerostatic Society. Mr. Glaisher, F.R.S., Dr. Lee, and other learned men have signified their intention of being members of the council; and it is understood that, as practical matters are always foremost in the minds of Englishmen, the society will make it their first object to facilitate both ascension and descension without waste either of gas or of ballast. They hope afterwards to apply aerostation for the purpose of foreign exploration and military observation.

The Friction Break.—Mr. Charles T. Porter has made some careful experiments, in which the power of a steam-engine was simultaneously measured by the friction break and the indicator. They show so singular a discrepancy, that he has concluded the friction-break to be a fallacious test of engine-power. No satisfactory explanation of the difference has yet been suggested. The power calculated from the weight on the break is greater than that shown by the indicator.

The Bernott Patent File Company are now, after surmounting many difficulties, manufacturing files by their new automatic machinery. The apparatus for rolling the most difficult forms of taper files has been perfected. It is now in course of erection at the works at Smethwick, and will shortly be in operation.

BARON SWEDENBORG.

The mention of this philosopher's name, casually, a week or two since, in a short article, appearing in our columns, having evoked sundry inquiries from correspondents evincing a desire to know more of this great man, we have made arrangements with a gentleman to supply us with a Biographical Review, and Portrait; the first section of which will appear, if possible, in our next.

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TO ADVERTISERS AND CORRESPONDENTS.

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All Advertisements should be sent to us not later than Friday.

The English Mechanic.

FRIDAY, OCTOBER 13TH, 1865.

THE SOCIAL SCIENCE CONGRESS.

FOLLOWING the flight of the British Association *savants* comes that of the Professors of Social Science, male and female—for here, at least, woman asserts her rights and lefts—who have this year chosen Sheffield for a temporary roost. Foremost now, as of old, where good is to be done, was Harry Brougham as President, who took up the thread where it was dropped last year, and lucidly expounded from the text, What has been done for the good of mankind, in Britain, during the past twelve months. From the Sacred Book to the humble pennyworth he travelled, taking in the ballot, extension of the suffrage, co-operation, savings banks, Government annuities, education, help for the helpless, prison discipline, law, logic—everything appertaining to social science was happily touched upon by the venerable, as indefatigable president; and though the bent head and feeble frame denoted that Time was doing his work upon this noble son of toil, yet it was not until after half an hour's reading that his lordship had to hand over the finishing of his presidential task to Mr. Hastings; and then it was the wisdom of the ancient from the lips of the modern. It is not to be expected that we can give room to the address in full. Some extracts we may be able to give of more than usual interest; but our readers will doubtless possess themselves of the entire document, which is well worthy of preservation as a record of the progress made in the science in the "Congress year" last past.

There is one point we wish to see touched upon, and that is the giving of a per centage of profits by employers to the employed. It has been adopted in several large concerns, and with benefit doubtless to all concerned; it has the charm about it of the "family," and, if properly gone about, would do away with many of the heart-burnings which exist, and which have yet to run their bad race, and do damage in strikes and lockouts. It covers the whole ground nearly of the majority of disputes, and is well worth the attention of the employer class throughout the land. Some may call it nonsense and utopian. We don't; and dare be sworn to our opinion that the places in which this "share" system is carried out honestly and fraternally will know strikes no more.

We have spoken of the Congress in question as one in which the gentler sex can come out as strong as they like; doubtless, as we write, they are doing so as of yore—for, on anything on which their sweet lips may be privileged to open, they give tongue most fluently. We would suggest, however, their forming themselves into an independent association: it looks so, to be hanging on to a masculine affair! And then we could admire the fluency of the writers, and the soundness of their logic much better, and be far more able to see exactly where woman was made to shine.

The Association, we need scarcely say, has our best wishes, as it has those of every well-wisher of his country, including every man and boy among our subscribers.

CHEMICAL AND MECHANICAL OIL-TESTS.

THERE are, comparatively speaking, but few substances, the adulteration of which is so frequent, and so difficult to detect, as that of animal and vegetable oils and lubricants. We propose, therefore, to give a short account of the means employed for detecting the adulteration of lubricants with other oils, and also of the manner in which their qualities are usually ascertained.

The kind of oil used for adulterating other lubricants depends, of course, on the comparative price of oils. Thus, although rape oil and poppy oil are generally cheaper than olive oil, and hence are often used for adulterating the latter, yet a change in price has sometimes caused just the contrary adulteration to take place. But, generally, table olive is adulterated with poppy, sesame, or nut oil; olive oil for machinery, &c., with rape oil; rape oil with poppy, nut, linseed, and more frequently with whale or train oil; linseed oil very frequently with the coarser kinds of olive and rape oil; and sperm oil with nut oil.

The usual tests for oils and lubricants may be divided into chemical and mechanical tests.

The former at once show the kind of oil employed for adulteration, whilst the latter indicate this indirectly, by proving the physical qualities of the lubricant.

Chemical tests usually show the nature of an oil by inducing a peculiar colouration, or a change in consistency, or a rise in temperature.

A very explicit account of the striking effects produced by sulphuric, nitric, phosphoric acid, caustic, soda, on various oils, is given in an article by Mr. F. Grace Calvert, F.R.S., in the *Philosophical Magazine*, February, 1854, and reprinted in Ure's "Dictionary," and elsewhere. He states that one part, by bulk, of sulphuric acid having a specific gravity of 1·475, mixed with five of oil, shows, after 15 minutes, a very green colour if linseed or hempseed, and a red colour if a fish oil be present. By these means 10 per cent. of either of the first oils may be detected. As little as one part of fish oil in 1,000 parts of another oil may be discovered from the dark red to black colour imparted exclusively to fish oils, by mixing with 1-5th part of syrupy trihydrated phosphuric acid. Other very characteristic reactions are obtained by adding first nitric acid or aqua regia, and then caustic soda. For further details of these very extensive researches by Mr. Calvert, we refer to the above-mentioned publications.

A more easy test is the unvarying rise in temperature that takes place on the addition of one-

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third of monohydrated sulphuric acid. This is the most concentrated form of the acid, and is obtained by distilling that of commerce.

Olive oil rises 68 degrees Fahr., poppy oil 126 degrees, and rape oil 100 degrees. With linseed oil the action is so powerful, that the monohydrated acid can only be used when mixed with 10 per cent. of the acid of commerce. With this mixture of acids linseed oil rises 135° in temperature, whilst rape oil rises 68°, and olive about 56°.

Schneider detects rape oil in other oils by dissolving the oils in question in ether, and then thoroughly mixing with it 20 to 30 drops of a solution of nitrate of silver in alcohol. The mixture is left for a short time in a shady place, when, if much rape oil is present, the lower part turns brown, and, finally, black; with a smaller quantity on the other hand, a distinct brown colour appears after, at most, 12 hours.

Resin oil may be detected in other oils by adding 10 parts of ethylene alcohol, Sp. gr. 0·83, and shaking the mixture for about a quarter of an hour. The upper milky strata will then contain the resin dissolved, and, if filtered and cautiously evaporated, will leave the resin as residue.

A Frenchman, M. Haucecorne, has found binoxide of hydrogen, or oxygenated water, an excellent test for olive oil. By adding one-fourth of binoxide of hydrogen and shaking up the mixture pure olive oil turns applegreen; poppy oil, flesh coloured; sesame oil, bright red; and nut oil, milky and greyish yellow. He tested in this way 292 samples of French olive oil, and found one hundred adulterated with nut oil, six with sesame, and only one with poppy oil.

(To be continued.)

PHOTOGRAPHY.

Splitting of Collodion Films.—The Editor of the *American Journal of Photography*, in reprinting an article from the *Photographic News* on this subject, adds:—"A more frequent occasion of exfoliation than any of those above enumerated is the acid condition of the plate. If the plates have been treated with acid, any amount of washing in simple water will not remove the acid effect, when there is a tendency otherwise towards exfoliation. Any alkali neutralizes all the acid."

Meetings of Societies.—We remind those of our readers concerned that the winter session of meetings of most of the societies will commence next month. The North London Meeting will be held at Myddleton Hall, and the South London Meeting at the City of London College.

Photographs of Welsh Bards, &c.—At the Eisteddfod just close to Aberystwyth, Mr. W. Griffith received the first prize, a silver medal, for his series of photographic portraits of Welsh bards, minstrels, and literary, scientific, artistic, and other popular men.

Stains in Prints.—A correspondent of the *Photographic News*, who was recently troubled with peculiar stains of one shape on the back of his prints which extended to the front, informs us that he has found the cause in a japanned waiter, upon which the prints were laid to dry. We presume it had been japanned iron, and the japan had been removed in one place, thus staining the prints with iron. It often strikes us with surprise to witness little acts of carelessness of this kind, the source of numerous troubles which photographers thus voluntarily encounter.

Splitting of the Film and the Gelatine Developer.—Another correspondent, signing "Kent," informs us that he has suffered from films splitting off where he has used the gelatino-iron developer but that a coating of dilute gum arabic before drying the plate prevents it. We cannot see any reason why this developer should produce such an effect, as its whole tendencies would seem to be in the opposite direction. If in the preparation of this developer, free sulphuric acid were left, it possibly might produce such a result; but if the developer be prepared properly, splitting of the film is most probably the result of an extraneous cause which chances to be present. See an interesting letter on this developer by Mr. Nelson K. Cherrill, in the present number.—*Photographic News.*

Trial of the New Jersey Flying Machine.—We are informed that the flying machine which has been in process of construction in Jersey City, and which has been incorrectly called the Government flying machine, as the Government had nothing to do with it, has been completed and tried. It of course failed, as everybody of any judgment knew that it would. They could not get it off the ground.—*Scientific American.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

LAPIDARY.

Sir,—Some of the following information may perhaps interest your correspondent "Lapidary." The manufacture of articles made of agate, cornelian, and similar stones, is principally carried on in a small district of Germany, adjoining Rhenish Prussia, and the Palatinate. The stones having been first chipped into pieces of a suitable size, are ground to the required form on circular stones, about 5 feet in diameter, revolving vertically, and driven by water-power. The various indentations are produced by suitable grooves and ridges, that are first cut on the grinders by a hard stone, generally a kind of graywacke. The lapidaries work in a horizontal posture, face downwards, their chest being supported by a kind of inverted wooden saddle, placed in front of the grinders, and about two feet from the ground. In this position, and with the assistance of a footboard, the workman can exert considerable pressure. Where perforations or very intricate forms occur in the pattern, recourse is had to the drill and lathe, assisted by diamond powder. The stones are finally polished upon wooden rollers, also furnished with suitable grooves, and smeared with tripoli powder and water. Sometimes the tripoli powder is moistened with sulphuric acid; but, if possible, this method is avoided, as the corrosive action o the acid sooner or later destroys the polish. M.

OUR SUBSCRIBERS NOTES AND QUERIES.

Cement.—Required for uniting cast-iron to glass.—Wm. Hudson.

Velocipedes.—Any recent work on the construction of these, or information how to proceed?—N. J. W.

Cement.—Required for uniting glass and wood?—Magnetic.

Electric Spark.—Can I get the electric spark, or make the electro-magnet, from the magneto-electric machine?—J. Newton.

Working Tools.—Where to get a book giving a practical account of how to work with smiths' and engineers' handtools—such as the scraper, file, chisel, &c.; also, turning and forging small articles.—W. Gray.

Cement.—A quick drying, fast-holding cement to combine flannel and iron, which has to do a deal of hard work as a roller.—B. Y.

Apprentice.—Where can I apprentice or article myself as an engineer? I am 19, and have been in the trade between three and four years.—Half Mechanic.

Fans.—At what speed should an eccentric fan revolve to exhaust heated air or dust along a pipe? What should be area of exit pipe, and what the power necessary to drive fan of following dimensions:—Circumference (measuring round the extreme end of leaves, 5 in number) about 6ft. 9in.; diameter to end of leaves, 3ft. 2½in.; size of leaves, 8in. × 9 in.—W. Lewis.

Kerosene.—Can any one tell me whence and how this is obtained?—Alpha.

Mahogany Dye, &c.—Wanted, a recipe for making mahogany dye; also, one for preparing gold leaf for illuminating paintings, &c.—Z. Y. X.

Blacking Slides.—What is the dead black, and how used, for astronomical slides in the magic lantern?—R. B. Jordan.

Tools for Springs.—Wanted, to know the method of making tools for turning up spiral springs, the size for each number of wire, and how used?—A Liverpool Watchmaker.

Cement, &c.—What kind of cement will fasten wood to metal to withstand action of heat? Can I dissolve shellac without spirit? Can plaster of Paris be made to withstand moderate heat, and how? If not, what plastic substance will?—J. J.

Electric Coil.—Can I make a coil of the following description to work:—The core is ½ inch thick, 5 inches long; the brass tube to draw out has 102° marked on it; contact breaker is on the side of the disc of wood? I have ¼lb. No. 16 cotton-covered copper wire, and ¼lb. No. 28 do.—G. Tolman.

Boiler Proportions.—The best size of boiler (in cubic feet) for a cylinder 8 inch stroke, and 3 inch diameter, at a pressure of 30lbs.—W. D. Wansbrough.

Gelatine, &c.—How are the gelatine "motto" cards manufactured? also, artificial slates and parchment?—Aaron Lloyd.

Bleaching Resin.—How to bleach resin white.—A. L.

Willis's Mechanics.—Who is the publisher, and what is the price, of "Willis on Mechanics?"—T. Harrison.

True Face-plate.—How can I make a perfectly true faceplate 18×24 in.? Also, how to test oil while purchasing it, so as to see if it be non-clogging?—D'Aubigne.

Cylinder.—What should be the size of a high-pressure cylinder, for economy and power? The low pressure is 20 in. in diameter, and works at 50lb. pressure; how many horse power would it be called?—W. J. J.

Electricity.—What would be the price of a small electro-magnetic machine—single or double magnet—for experiments in a lecture-room? Where could I get carbons and batteries, and their prices?—J. W. Merthyr.

Paraffin Burners.—How to fasten burners on paraffin lamps?—Subscriber.

Japanning.—The best way to japan bull's-eye lamps, and what kind of japan to use?—A Subscriber.

Polishing Japanned Work.—How best to do it?—J. Jeffery.

[Such as are baked in ovens, for the evaporation of the solvent of the varnish, are first forwarded with pumice-stone powder applied with water, or list, or flannel; 2nd, they are polished either with rotten-stone, or putty powder and oil, also on flannel; and, with the dry hand and rotten-stone.]

Preparing Silk.—What is the art of preparing silk or fancy stuffs for covering fans and fancy goods?—John Jeffery.

Die Counterpart.—How to make a counterpart for a steel die for producing stamped brass ornaments in a fly press in large quantities?—Amateur Die Sinker.

[We have seen a fair one produced in lead, taken from the other, well hooped in.]

Shoemaker's Bench.—Is there a patent bench for shoemaker's to stand to work at? If so, who is the patentee, and where may one be had? Also the best sewing machine for shoe making in general use, and price?—B. M. T.

Velocipede.—Will any one tell "J. B. H." where he can get information how to set about making one?

Microscope Condenser.—Can the inventor tell me the expense of the condenser described by him in No. 6, and where it may be bought?—W. O.

Cardboard.—Is there a machine in existence for pasting cardboard (single sheets or otherwise), and if so, where can I get one?—Card Maker.

"Pinning" of Files.—Wanted, a remedy for the "pinning" of files, where to procure fine plaster of Paris, a good handy book on turning in iron and brass, &c.—Postulata.

Small Castings.—How can I melt small quantities of iron for casting small pieces of machinery? Also, a description of the tools necessary in the operation.—B. L. B.

Electro-Magnet.—What size of wire is required for making one, to give strong shocks, and how much required?—J. D. E.

Case Hardening.—The best mode for case hardening angle iron; also, how to calculate the wheels for screw cutting with the slide rule?—J. D. E.

[We described a method of case hardening, both large and small work, some time ago. There is a turner's and fitter's pocket-book for calculating the change wheels for screws on a turning lathe, by J. La Nocea, price 6d., sold by Spon. There is also the book advertised in our columns by James Martin.]

Induction Coil.—Having paid over £6 for materials for an induction coil giving long sparks, constructed it by binding the secondary as cotton on a bobbin, and insulating with gutta percha, but having failed to get a satisfactory result; perhaps some of your expert correspondents in electricity could tell me of some plan of construction, so that in the event of a break in the passage of the secondary current through some miles of wire, it may be corrected without uncoiling all the wire, and having to rewind it.—W. O.

Ropes for Turret Clocks.—What is the best wire rope for turret clocks, copper or steel, the size to carry a 19 stone weight, and the best place to purchase them?—Thomas Tompion.

Cylinder.—What size cylinder will a boiler 3 feet long, and 20 inches diameter, of square end form, drive? Also, any easy rule to find the size of cylinder required, the full dimension of boiler being given.—John James.

TO HARDEN COFFEE MILLS.

"A. Smith" (No. 27, p. 8), does not say what particular preparation of potash, and as there are a great number, perhaps he will be so kind as to give the precise kind, else his information as it stands at present is useless, for it would be no use to go into a shop and ask for 3d. worth of potash.

Give and Take.

VEHICLE FOR COLOUR.

Could you kindly give me shellac and borax, say, to a pint of water, the time of boiling, and also the kind of shellac, if so, you will greatly oblige. Give and Take.

[The correspondent who forwarded the recipe, will, perhaps forward full directions for the benefit of "Give and Take," and other subscribers.—Ed. E. M.]

PEROXIDE OF BARIUM.

Sir,—In answer to "Chemicus," (Derby), Binoxide or Peroxide of Barium Ba ($O^2 = 10·5$), a greyish powder. It is prepared by passing dry oxygen gas slowly over anhydrous barytes, carefully prepared from the nitrate in a hard glass tube, or by sprinkling chlorate of potash in small portions over barytes, at a low red heat in a platinum crucible, and washing out the chloride of potassium with water, the hydrated binoxide remaining (Liebig).

Alpha.

PETROLEUM, A STEAM FUEL.

Sir,—A paragraph appeared lately in a daily paper respecting petroleum as a steam fuel. Whale oil is mentioned in it as being a hydro-carbon. It should have been Shale oil. The manufacture of shale and coal is destined to become one of the principal branches of industry in this country; their excellence have all but driven out the American petroleum. The public appear to know very little respecting them. These British hydro-carbons are only about half the price of the American. The best are of specific gravities from 850° and 900°, water being taken as the standard at 1,000°; in using them as steam fuel their specific gravity is not, I believe, of much importance. The manufacturers have a coal that produces good crude oil, unfit for refiners, but which would do for fuel. This would be at about one third the price of the American. As a steam fuel they are far more powerful than coal, and for marine engines will, before any very long period, entirely supersede it.

C. J. Richardson.

HEATING GREENHOUSES.

Sir,—In reply to "Ironmonger," to heat a forcing house to about 80 degrees Fahrenheit above surrounding temperatures:—Rule:—Multiply the length of the house in feet by the width, and this product by two thirds of the greatest height, and divide this by 10, which will give the length of 2in. hot water pipes; for 3in. pipe, divide by 14; for 4in. ditto, divide by 19.

Example: required the length of 3 in. pipe to heat a

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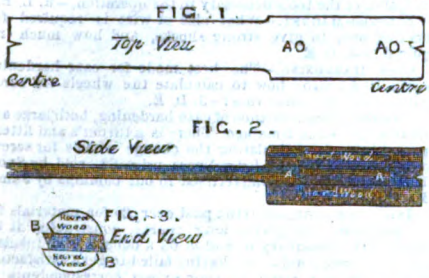
forcing house to 80 degrees above surrounding temperature. Size, 100 feet long by 30 feet wide, and 15 high at back; $10 \times 30 = 3000 \times 10 (=\frac{3}{8}) = 30,000 \div 14 = 2,144$ = (feet required.) The tube to heat a greenhouse is much the same, only divide by 15 for 2 in.; by 22 for 3 in.; by 23 for 4 inch. Example: $50 \times 20 = 1,000 \times 8 (=\frac{2}{3}) = 8,000 \div 28 = 286$ feet of 4 in. pipe. There are a great many kinds of boilers now in use, and all have their special attractions, but the one I should recommend as the most serviceable is an upright tubular boiler made by Lynch White, of London, where you can also be supplied with all kinds of fittings, pipes, &c. The usual means of making the joints is with tin cement or red lead, and spun yarn, and I should recommend the latter as preferable, having had considerable experience in the uses of both. W. H. WALLACE.

BORING SMALL CYLINDERS.

Sir,—In answer to "J. H. J." in No. 27, the best way to bore small cylinders is to fix a piece of hard wood to the face plate or chuck, and bore out the wood so as to allow the cylinder to be driven up tight, then take a roughing, cut up the cylinder with an ordinary boring tool within 1-16th of an inch of the required size, then for a nice smooth finish use such a tool as represented in the sketch.



The pieces of hard wood are screwed from one to the other, as represented at *A*, and a gutter cut up, as at *B* in Fig. 3, to allow for clearance. JOHN SWIFT.

NEGATIVE SLIP.

Sir,—I noticed an elaborate report in the *Times* of the trial trip of the *Bellerophon*. The writer says a great deal about "negative slip," but does not attempt to account for it.

This I understand to mean, that the vessel is actually going through the water faster than her screw is propelling her—in other words, that she is dragging the screw through the water. In the case of the *Bellerophon*, it is said that she was overrunning her screw to the extent of a mile and a half per hour.

It seems to me very strange that this phenomenon has never been satisfactorily accounted for, and I hope that your correspondents may be induced to broach some theory that will account for it. W. G. W.

MARINE GLUE.

Sir,—In answer to "J. Bunney," Aug. 18th,—Marine glue is made in the following manner:—

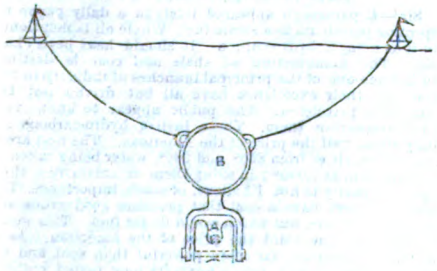
Make a solution of good caoutchouc with coal naphtha in the proportion of 1lb of caoutchouc to five gallons of naphtha. In about twelve days it will be dissolved to the consistency of cream, when two parts of shellac should be added to one of the solution; it should then be heated, and stirred till well amalgamated.

I should think that this glue would also suit young "Warwick," whose query is in your magazine of the 11th of August. J. D. E.

[See "Notes and Queries."]

THE ATLANTIC CABLE.

Sir,—To raise the cable by under running, I propose to construct a hollow metal buoy, of a cigar or fish shape, filled with compressed air, and surmounting a strong steel Y-shaped frame, carrying a deeply-grooved gun metal sheave for the cable to run in. On the buoy shall be a hoop, or



A, cable; B, section of buoy.

band, carrying two eyes, for the insertion of lifting chains or ropes, the submerged buoy to be propelled by two steamers, till the whereabouts of the broken end be nearly arrived at, the vessels to be then joined by the *Great Eastern*, whose immense power and appliances would materially assist the actual force; and the end once happily lifted, the "paying-out" would then be of a different character and results to the paying-out of the unfortunate shareholders at present. EDMUND DEARN,
Engineer, Maldon.

ALUMINIUM BRONZE.

Sir,—"Neophyte," in No. 23, may obtain this by strongly heating in a crucible pure alumina, finely-powdered charcoal, and a very pure copper, finely divided—that from Lake Superior ore is preferred. The strength of the alloy composed of copper, 90 parts, and aluminium 10 parts, is, per square inch, tenacity, 73,185 lbs., or 1185 lbs. more than the average capacity of cast-steel; resistance to compression, 132,416 lbs., Sp. gr. 7·689. J. H. M.

CYLINDER AND BOILER.

Sir,—Your correspondent "Machina vi Vaporis" makes enquiry, what size boiler he requires for an engine whose cylinder is 2½ inch bore, 5 inch long, and powerful enough to drive a lathe.

I have a wrought close-range boiler, ¼ inch plate, 11 inches high, 6 inches wide, 28 inches long, and 10 inches wide, which I have used for driving a lathe with a cylinder about the size of M. V.'s, with steam at 15lbs. per square inch.

I wish to dispose of it, and if it will suit M. vi V., it can be seen at Messrs. Wiley and Ranger's, ironmongers, Upper-street, Islington. JAMES STOCKBRIDGE.

LATHE.

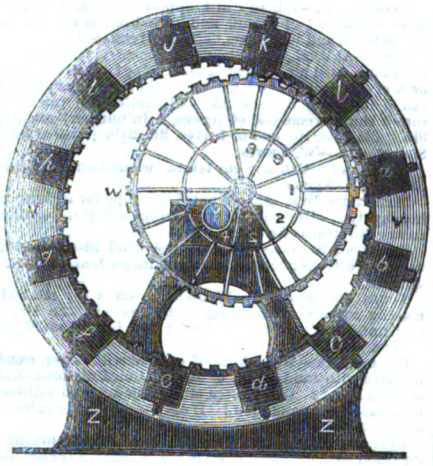
Sir,—In reply to "Sytematic's" enquiry,—He may turn a crank by placing a strong carrier at each end of his shaft, pitching his centres in the carriers, and taking care to block up the ends by a shore from the crank on each side. If necessary, place a counterpoise to balance the weight of the shaft. The bearings on the shaft may be turned in the ordinary way, only take care to place a blocking in the crank, to prevent its breaking with the pressure on the centres.

Can any of your valuable correspondents tell me of any machinery that has been invented for strengthening iron wire from the coil other than setting with a hammer? I have some 21 lengths of 14 wire to get up straight, and I find the setting rather tedious, and they are too rigid to get straight by pulling. NIMROD.

ELECTRO-MAGNETIC MACHINE.

Sir,—Being simply a mechanic, and not an electrician, I may say something nonsensical if I venture out of my proper sphere.

I will, however, give you an outline of the mechanical part of an electro-magnetic engine, which I have been pondering for some time.



Z is the sole plate carrying the wooden disc V, and the crank shaft *y*.

W is a wheel-mounted on crank pin, and furnished with nine armatures.

On V are placed twelve electro magnets, *a*, *b*, *c*, *d*. &c.

The wheel W and the disc V are supplied with teeth, to cause the armatures to fall direct on the magnets.

On the shaft *y* is to be placed a barrel, with twelve prongs, to strike keys, in the barrel-organ fashion, so as to make the communication between the battery and the magnets in succession.

The shaft Y is to be furnished with a fly-wheel, loaded so as to counterbalance the wheel W.

Such is my idea of the mechanical part of the business. Our electrical friends will, I hope, be able to supply the he rest. ROBERT SLOANE (Glasgow).

MAKING HOLES IN GLASS.

Sir,—By using camphor and oil of turpentine a hole can be bored in glass with a 3-cornered drill; also, a watch-spring made into a saw will saw flat glass, and a female screw can be made in plate glass. J. S.

[We answered an inquiry of the nature of the one you make immediately it was sent us, under heading "J. Stewart."]

COMPRESSION FAUCET.

Sir,—In the concluding number of the first volume, the beautiful illustrated description of a compression faucet agrees, in all particulars with one invented some thirty years ago by John and Robert Heart, of this city. I fixed them on for the inventors as kitchen taps, and to supply the water-closet cisterns in a new property, Bath-street.

They are particularly well adapted for street wells, for which purpose a good many are used. J. HILLS.

Glasgow, Oct. 1st, 1865.

ARMOUR PLATES.

Sir,—"S. E. E. M." (No. 15) may submit his plans to the Under-Secretary of War, Pall-Mall, and he will probably receive—thanks. J. H. M.

DEPOSITING ALUMINIUM.

Sir,—In reply to "J. R." (No. 15), he will find several patents:—Jurist's is No. 1183, Dec. 28, 1852; Thomas and Tilley's, No. 2756, Dec. 6, 1855. The latter dissolve hydrate of alumina in a solution of cyanide of potassium by boiling. This is filtered when cool, and a bag of alumina suspended in solution. J. H. M.

INDIAN INK.

Sir,—In answer of "S. F. F.," this is made from horse-beans, or from the kernels of the stones of apricots. Either is burnt in an oven till perfectly black, then ground to a fine powder, and made into a paste with a solution o gum arabic. It is then formed into long rectangular cakes J. H. M.

TEST FOR COIN.

If "James Ward" will try the following, I think it will suit his purpose well. Get a thin flat piece of zinc about the size of a shilling, and place the gold or silver coin on it, then put the two together into his mouth; if the coin be good, it will have a very peculiar taste, but if spurious, this will not take place.

Or, if the coin be wetted and a piece of lunar caustic be rubbed on it, if good no change takes place, but if spurious then it becomes quite black. ISAAC K. CLAYTON.

POROUS POTS.

In "Watt's Electro Metallurgy," Weale's series, 1s. 6d., a piece of ox gullet or windpipe is recommended as a substitute for the earthenware pot, and I have often wondered that no one has mentioned it before. I have never used it myself; I shall try it the next time I have occasion to use a battery, as my experience of the earthen pots is anything but satisfactory. GIVE AND TAKE.

MICROSCOPY.

A new dissecting microscope has been devised by Dr. Lawson, and manufactured for him by Mr. Charles Collins. It is of the class of simple microscopes; but is binocular, the lenses being semi-prismatic convex ones. The powers do not exceed six diameters; but Dr. Lawson considers that in the dissection of the lower animals such powers—when binocular—possess the following advantages over the ordinary dissecting lenses:—1st. That an abundance of room is left between the lens and the object, so as to admit of freedom of action of the operator's hands; 2nd. That the object may be easily and well illuminated by means of the "condenser;" and 3rd. That several structures situate at different levels are brought simultaneously into view. The stage of Dr. Lawson's instrument consists of an oblong trough of gutta-percha, in which small animals intended for dissection can be pinned under water. In the centre of this trough is inserted a small disc of glass, through which, from a mirror placed below the stage, a flood of light can be thrown upon transparent structures. Two arm-rests draw out on each side of the microscope, on which the wrists can be placed when the observer is at work. The upper and front portions of the case unfold upon the table, and display a series of scalpels, needles, scissors, &c., necessary for the dissection of animal tissues. When closed, the new binocular presents the appearance of an oblong mahogany box, about six inches long by three and a half wide. Its magnifying power is low; but this is more than compensated for by the relief which is given to the object under view, and the large amount of penetration which the glasses possess.

EMIGRATION IN THE IRON AND COAL DISTRICTS.

During the past two years, as has been noticed in the public journals, there has been a continual drain of emigrants from the iron and coal districts of South Wales, the great majority of them leaving for the States. Such was the drain at one time among the working population that a positive scarcity of hands was experienced at many of the works, and considerable inconvenience and loss were the result to employers. Since the close of the American war however, the emigration movement has been gradually checked, and, in fact, a good number of the emigrants have returned to the mother country, and they give a deplorable account of the state of the labour market in the States. The warnings that appeared from time to time in the daily papers have thus been verified, and now, when it is too late, many of the emigrants regret that they ever left the land of their birth. There is no doubt that a higher rate of wages is paid in America, but the depreciation in paper money and the dearness of all the staple articles of food reduce the earnings so must that a working man is, after all, better off in the industrial districts of Great Britain.

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SMALL ARMS MANUFACTURE OF BIRMINGHAM.

By Mr. J. D. Goodman.*

The subject I have selected for elucidation is "The Statistics of the Small Arms Manufacture of Birmingham"—and that it is an important one to Birmingham may be considered from the fact that the workmen employed are estimated to number 7,340. Of these 3,420 are engaged in producing the materials, the barrel employing 700, the lock 1,200, the bayonet 500, and so on. Setting up these materials into guns employs 3,920 men. Of these the three chief branches are the stockers, screwers, and finishers. Each of these branches with its sub-branches is estimated to employ 1,000 men. The stocker lets the barrel and lock into the stock, and roughly shapes the stock. The screwer lets in the furniture and remaining part of the gun, and further shapes the stock. The finisher takes the gun to pieces, and distributes the several parts to the browner of the barrel, the polisher, the engraver, &c., and when they are returned he puts the gun together, and finally adjusts the several parts. The out-working system leads to the employment of a considerable number of young boys, who are employed mainly in carrying the work from one to another as it passes through its several stages. No very correct estimate can be given of the rate of wages earned by the workmen in the gun trade. With very few exceptions the work is paid for by the piece, and the rate varies considerably with the demand. During the past ten years there is little doubt but that the wages earned in this trade have probably exceeded those in any other. Several branches require very high skill, and the remuneration is in proportion; for instance, barrel boring and setting, stocking, rifling, lock filing, &c. A judgment can be formed of the delicacy of workmanship required in the first of these branches when it is stated that a military barrel has to be bored with such truth that it must receive a plug measureing 577 thousandths of an inch, and is condemned as useless if it take one of 580. A workman in this branch in full employment has frequently been known to earn his 5*l.* to 6*l.* a week. It is a very common practice in many of the branches for a workman to employ several assistants, whether working in the factory of his employer or as an out-worker. Such men, while paying those under them at the rate of 5s. to 10s. for boys, and adults 15s. to 25s. per week, will take for their own share several pounds. A workman is held to be an inferior hand who in any of the skilled branches cannot earn single-handed, when work is at all brisk, 30s. per week. The Birmingham gunmakers have long been aware that a more extensive use must be made of the advantages which they possess, and this has led to the erection in Birmingham of an establishment for the manufacture of guns by machinery on the interchangeable principle. We must give America credit for the introduction of this system. It was thence that it was brought into this country. The factory of the Birmingham Small Arms Company is now in working operation. The system is there carried out in its full integrity. It has been planned on a scale to produce 1,000 guns per week. There are upwards of 300 machines at work, but at present it has not reached its full power. The number of guns now made there is about 500 per week. From a return published of the number of barrels made for the Government in the years 1804 to 1815 the total was 3,037,644, or an average number of 2,531,137 annually. In 1804 the number produced was 80,000. It steadily increased up to 1813, when it reached 490,000 in that one year made for the Board of Ordnance alone. During this period Birmingham produced barrels and other materials for the India Company, amounting to a million. This makes the total number of arms made in the 12 years somewhat over four millions, or 1,074 per working day. A large number of these materials, manufactured in Birmingham, were made up into guns by the London gunmakers. To verify the traditional "gun a minute," said to have been the production of Birmingham during this war, we require 1,440 guns per day, or 525,000 per year. For this we must confine ourselves to the two highest years, 1812 and 1813, which produced respectively, including the India Company's supply, 381,682 and 654,450. It will be instructive to compare with the results now given the production of the French Government during the same period. The information is obtained from returns published in 1822 by M. Dupin, a field officer in the French service. During the years 1802 and 1814, a period of 13 years, the arms manufactured by France numbered 2,456,257, or about 200,000 annually. This number gives us for every working day 604 guns. The number made in England, it will be recollected, being 1,074 per working day. At this time, it must be borne in mind that France had at her command the resources of Liege and Turin, in addition to her own. St. Etienne, the most important seat of the arms manufacture in France, supplied 754,000, while Liege produced 279,900, and Turin 107,000. Seven other towns supplied the remainder. The total number of guns proved in the period from 1859 to 1864 was 6,116,305. Of this number there were proved at the Birmingham trade proof house, 3,277,815; at the Government proof house at Birmingham, 978,249 (these last represent military guns made for the English service); at the London proof house, 1,325,139; and at the Enfield factory, 505,102. The Enfield factory has only been in operation seven years. The average annual production will thus be:—Birmingham trade proof house, 327,781; Birmingham Government proof house, 97,824; London trade proof house, 135,513; Enfield proof house, 72,154; making a total annual production for the whole of England of 633,272. From the returns I have in my possession, I have drawn out as accurately as I possibly can the number of arms manufactured in Birmingham and elsewhere for the Americans during the last four years. The first shot was fired at Fort Sumter on the 12th of September, 1861. On the 9th May following five purchasers of arms, some commissioned by different Northern States, others private speculators, arrived in Birmingham. Each had so well kept secret the object of his mission that when they found themselves all engaged in Birmingham on the same errand they suspected each other purchasing for the enemy, and their anxiety was increased accordingly, to secure the few thousand arms that were then in store in Birmingham. The few in hand were at once shipped off, and large orders were given, which continued to occupy the trade at their full power with one interval till March, 1863. The interval I allude to was on the occurrence of the Trent affair, in November, 1861, which led to an embargo being laid on the export of arms on December 4, 1861. This embargo was removed early in 1862. On the removal of the embargo one steamer took out from Southampton no less than about 40,000 rifles to New York. The trade worked at its full power, straining every nerve till, I find by the return of the Birmingham proof house, that in one month, the month of October, 1863, 60,343 rifle barrels were proved, being very few short of 2,000 per day from Birmingham alone, a number altogether unprecedented in the history of the trade. At that time the supplies produced in America at the Springfield Armoury, and elsewhere, began to tell upon the demand. We still find, however, that the numbers were 40,000 to 50,000 per month till March, 1863, They then fell to 14,000 per month, till in September, 1863, the Northern demand ceased altogether. Without notice the orders were suspended, and guns that had been sent over were even returned to this country. The United States Government found at that time their factories were equal to supply the whole demand. From the proof-house returns I obtain the following numbers, showing the extent of the supply of arms from this country to America:—Birmingham supplied 682,534; London, 344,802; making a total number of Enfield rifles sent to America of 1,027,336. The price of the arms manufactured by the English trade for Government use he estimated at £3. Data were given of the number of guns made in Belgium and England, and as to the future the paper said:—"It is manifest that the Birmingham gun trade must be on the alert if it is to maintain its ground. To contend against the cheap labour of Liege is not an easy task. The establishment of the machine factory, we hope, is a step in the right direction. It will secure for the town the trade in the highest class of military work, which otherwise would have gone to our competitors. Excessive prices for labour are still paid in certain branches of the work, particularly when sudden pressure comes upon the trade. A more uniform rate of wages would benefit all parties, and the master would feel more confidence in tendering for contracts at moderate rates, and the workmen would secure more regular employment. I hope the facts now produced, and which will subsequently be given more in detail, will serve to call the attention of the trade to points so closely affecting its future progress and well doing."

*Read before the British Association.

Dr. Draper, of New York, has succeeded in taking a photograph of the moon 40 in. in diameter.

The magnesium light is found to be sufficiently active to determine the combination of hydrogen and chlorine.

THE COAL FIELDS OF THE MIDLAND COUNTIES.*

Both the extension and duration of the coal-field are questions open to a very great difference of opinion. If the extent was limited to the at present explored portion of the district the duration might be tolerably accurately calculated, as all the coals that can be possibly reckoned upon in a descending order in this coal-field have long since been discovered. It is to the confines of the present coal-field, then, that any hopes for fresh supplies can be looked for, and it is a very interesting fact that on all roes of the coal-field explorations are being most successfully carried on, with, perhaps, the exception of the eastern boundary on Birmingham side. But the coal depth at which the thick coal has been worked in the neighbourhood of West Bromwich is about 400 yards in depth. The result of operations now going on in other portions of the coal-field is, however, being looked forward to with great interest, as affording sufficient evidence to warrant an attempt to reach the coal in the neighbourhood of Smethwick and Harborne. During the last ten years, more especially the last five years, a great number of new winning have been made on north end or Cannock Chase district, as also on the north-east at Aldridge, and at Hanley and other places; but probably the most important recent trial sinkings are those on the south end of the coal-field in the neighbourhood of Halesowen, Congreaves, Cradley Park, and Wassel-grove. In the event of the one at Halesowen and that of Wassel-grove discovering the thick coal, both of which look very promising, and are now sunk to about half-way to the coal, more than 4,000 acres of the thick seam may be considered proved, and this assurance will no doubt give a fresh impetus to additional research even further south than those now in operation. Very rapid strides are now being made in developing the thin seams over several thousand acres of previously unexplored ground on Cannock Chase, which is now being intersected by canals and railways in every direction. These thin seams are, however, exhausted as compared with the thick coal seam. To attempt to estimate the probable duration of the Staffordshire coal-field, whilst these somewhat important recent additions are being added to it, would be impossible; but it may be observed that such additions are not keeping pace with the enormous consumption and consequent rapid destruction of the parent portion of the coal-field. In a very valuable paper read by Mr. Matthews, in August, 1860, after obtaining the best evidence upon the subject, he estimated the duration of all parts of the coal-field at an average of about forty years from that period. There can be no doubt but that in one-half that number of years a very large portion of the earlier developed part of the coal-field will be totally and for ever exhausted; as, for instance, the mines in the neighbourhood of Bilston, Coseley, Tipton, Wednesbury, Oldbury, Westbromwich, Brockmore, and Brierley-hill are being fast worked out, and in twenty years hence will be well-nigh totally exhausted.

THE TIN AND JAPAN TRADES AT BILSTON.

Bilston is distinguished for the production of japanned and tin ware, similar in kind, but rather lower in quality, than that manufactured in Wolverhampton. Trays and waiters are made in great quantities, one firm making 600 sets of trays (three forming a set) every month, and not less than 100 gross of waiters per week. These articles are all stamped, and are of a great variety of shapes, there being about 2,000 distinct patterns, either in shape or ornament. The most prevailing shapes, however, are convex, Gothic, and oval, the former having perhaps the greatest sale. They are japanned, and afterwards ornamented either with paint or gold leaf. Those for export trade are embellished in accordance with the prevailing taste of different markets, and it is a curious and interesting study to notice the varied styles of art most popular. For Brazil the most saleable ornament is a shield, surmounted by a crown, and encircled with coffee berries. For South America bright gaudy colours are mostly in demand. In Spain the most favourite ornament is the representation of a bird. It is not necessary that the artist should study the rules of natural history, so that the bird have brilliant coloured feathers. Red, blue, and yellow, are the most esteemed by the Spaniards, and the Bilston artists present them with more extraordinary specimens of ornithology than Buffon or Goldsmith ever dreamt of.

* Abstracted from paper read by Mr. Johnson, before Section D, British Association.

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NEW CHUCK FOR WOOD OR METAL.

Messrs. Editors (writes a correspondent of the *Scientific American*). Several kinds of chucks are employed for holding work between two centres; for wood, prong chucks or square hold are the most common; for metal, dogs are usually employed; the disadvantage of the above-named chucks for wood is, that the work frequently gets out of centre, when any pressure is used, and it cannot be taken on and off for examination without a risk of missing the centre, when replaced.

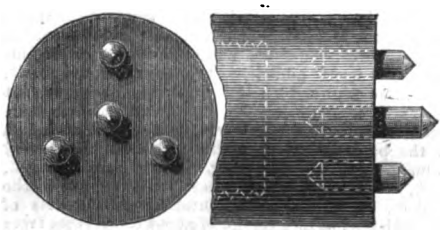
The disadvantage in using dogs, when turning metal, is the necessity of turning the work end for end, which requires the dogs to be shifted—when you wish to turn a cylinder, for instance, or when you wish to file a cylinder on the lathe; and another nuisance of dogs is, the catching of the tool or fingers against the projecting points of the dogs.

To obviate these inconveniences, I invented a very simple contrivance for holding work between two centres, which is equally applicable to wood or any kind of metal, and the same chuck will hold as firm as a vice a piece of wood or metal half an inch or even twelve inches in diameter. It, moreover, enables the tool of the slide rest, or the hand tool, to pass over the whole length of the work, without turning it end for end; and you can take the work off fifty times and replace it with perfect accuracy.

This chuck is merely a short cylinder of brass or of iron, which screws on to the lathe head with a steel point projecting from the centre of the other end, and three steel points at a short distance from this centre point, but not projecting quite as far out. These three points are equidistant from each other and from the centre point. The projection is about one-quarter of an inch, more or less, according to the nature of the work.

Fig. 1 show the face of the chuck with four points projecting. Fig. 2 shows a side view of the chuck.

FIG. 1. FIG. 2.



To make this chuck I drill four holes in the face of it, each about half an inch deep, with a drill corresponding with any size of Stubb's steel wire—one of my chucks is drilled to No. 15, another to 22. I then cut off three pieces of Stubb's steel wire of one size smaller than the holes drilled, and point each one on the lathe, and dip the blunt ends into melted tin after dipping them into muriate of zinc. I heat the chuck on a stove, drop into each hole a little muriate of zinc, and then, with a pair of pincers, put in the steel wires, with the points outward; and when cold the chuck is finished. To use it, drill a centre hole in each end of the work to be turned, with the same drill employed to make the four holes; put the centre point of the chuck into the centre hole of the work, give it a tap with a mallet, and you will have three marks which will enable you to drill the other three holes in the work, with the same drill.

These four points, when inserted into the piece to be turned, and when the other end of the piece is held by the point of the puppet head of the lathe, will keep it as firm as if held by a vice, and it can be taken off and replaced without regard to which of the three outer points is inserted—for if drilled equidistant, all will fit the work.

A bar of metal, in which the four holes have been drilled, can be used up until within one-fourth of an inch of the end, and once the chucks are made and the proper drill at hand, it will be found as easy to mark and drill the four holes in the work as to adjust and screw up a pair of dogs, especially if you have several pieces of metal or hard wood to turn.

Buffon combined plane glass mirrors only 6in. by 8in., and with 40 set on fire a tarred beech plank, 66ft. distant; with 98 at 126ft., with 112 at 138ft., with 168 at 200ft.; and he melted metals at 30ft. or 40ft.

Meteors and falling stars have been found by eminent astronomers to be minute planetary bodies. When visible they pass at a height of from fifty-two to seventy-three miles above the surface of the earth.

RICE AND EVERED'S TUBE SHEET CUTTER.

This tool is intended to bore the holes for flues or tubes, in the tube plates of locomotive or tubular boilers. It is designed to do extra good work, and is especially valuable where the tubes are close together, since, in plates that have a hole punched or drilled in them to guide the end of the old tool commonly used, there is great danger of the drill running out, or the holes being badly punched by careless persons. With this tool the work must always be first-class. The hole will be true with the centre, and, if the marker lays the sheet off properly, the tube plate will be a fac-simile of the draughtman's projection in the drawing room.

In detail, this tool is simply a steel shank, A, with a sleeve, B. This sleeve slides, but does not turn on the spindle, being held by the feather, C. There is a thread on the sleeve which fits the hollow shank of

FIG. 1.

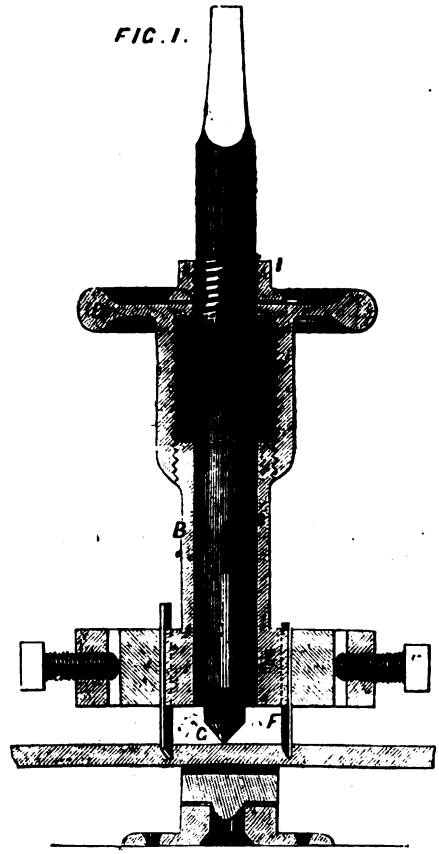
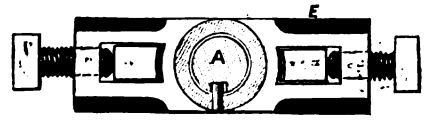


FIG. 2.



the hand wheel, D; when the wheel is turned, therefore, the sleeve is drawn up or down.

The lowest end of the sleeve is formed into a socket, E, in which the cutters, F, are held, and there is a centre, G, in the spindle, which works in in the centre punch mark in the work. The hand wheel rest on a collar, H, and is kept from rising by a nut, I, with a left-handed thread. There is a bracket, J, on the table which supports the sheet to be drilled. These are the details.

The inventors and manufacturers say:

"The object of this tool is to save time in drilling tube sheets, by not having to drill the centre hole, which is now either drilled or punched previously to cutting out the full-sized hole, thus saving one handling of the plates. There is also a saving of scrap iron, as thinner cutters can be used, and the centre hole is not cut out, but all left in a solid piece. This is no small item where much of this work is done; the difference in scrap iron would soon pay for the tool. It also takes less power to cut than with thick cutters. Another important item is the saving of cutters; these cutters are not half so liable to be broken as those in common use. The reason that these cutters are not so liable to break is, that there is no slack motion to the cutters; they cannot go through or draw themselves into the sheet any faster than the natural feed. All the holes must be, with this tool, cut exactly true with the centre punch mark; there is no chance for the drill to run; and where hole are drilled pretty close together, this is also a very important object—locomotive builders, especially, would find this a great help to them in doing good work. It is necessary to have a good solid drilling machine, in using this tool, in order to give the best results. We have used this tool for nearly a year, and are better satisfied with it every day, and have often cut at the rate of 600 holes two inches diameter in five-sixteenths iron, per day of ten hours. The patent for whole States is for sale. We can also manufacture the tools for sale, and have some on hand."

This invention was patented through the Scientific American Patent Agency on May 30, 1865, by D. E. Rice and William Evered, of Detroit, Michigan.

ELECTRICITY.

The Spectrum of the Electric Spark.—The indefatigable Abbe Laborde has made some important observations upon the spectrum of lightning, which are reported in our contemporary, *The Reader*. When the flash appears directly before the spectroscope, as he has been fortunate enough to see it three or four times, the bright lines of which the spectrum is composed are very numerous and well marked. More often the lightning is seen reflected from the clouds in its spectrum, the bright lines are still visible, and increase in number as the flash is more vivid. They are all of a dull white or lead colour, but one among them is always more apparent than the others, and is sometimes seen alone. This line is not far from Fraunhofer's line E. When, however, the flash appears at a great distance, or is seen through a thickness of cloud, almost all the bright lines disappear, and the spectrum is nearly continuous. The appearance is similar to that observed when several unpolished pieces of glass are placed between a source of light and the spectroscope. The Abbe remarks that, when lightning is observed by the spectroscope, it is therefore important to note the degree of visibility of the bright lines it gives, for the thickness and opacity of clouds can vary them greatly.

New Mode of Employing Bunsen's Battery.—M. Duchemin not long since announced to the Academy of Sciences that in Bunsen's battery the nitric acid could be replaced by perchloride of iron, and the sulphuric acid by a solution of common salt. He has now stated that by substituting crude chloride of potassium for the common salt, the electro-motive force of this battery is increased, and its caloric effects intensified; the electric light being easily produced when the chloride of potassium is employed, instead of chloride of sodium.

How to Make an Intermittent Fountain.—M. l'Abbe Laborde, writing to *Les Mondes*, describes a simple apparatus for producing an intermittent fountain. It consists of an inverted flash fitted with a cork, through which pass two tubes of unequal length. The longer reaches nearly to the bottom of the flask, and outside has a length of some twenty inches. The shorter tube merely pierces the cork, and does not extend to any length inside, and outside it ends immediately in a jet, which can be curved round. The flask is filled with water, fitted with the two tubes, and then, with the finger on the shorter tube, is inverted, plunging the end of the longer tube in a vessel of water. The instrument may now be fixed in this position, as an intermittent jet of water begins to flow at once, continuing until the flask is empty. The column of water in the longer tube will be seen to be alternately rising and falling, from which phenomena an explanation has been given of the cause of the intermittent flow.

A Powerful Thermo-Electric Battery.—At a meeting of the Royal Institution, held some time ago, Mr. Ladd exhibited in the library a powerfu thermo-electric battery, made in the manner invented by Marcus, of Vienna. Although the instrument consisted of only ten pairs, and the means of heating it by a row of gas jets had been hastily devised, yet, on making and breaking the circuit, a spark was readily obtained. The current from this thermo-electric battery was sent round an electro-magnet, and lifted a very considerable weight.

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EXPLOSION OF STEAM BOILERS.

A correspondent, in furnishing us with drawings illustrative of his panacea for prevention, states his reasons as follows:—

The principal causes of boiler explosions are: defective building, furrowing, and a few from miscellaneous causes. Boilers made with lapjoints are inferior in strength, as those joints have a tendency to weaken, one plate acting as a lever to tear asunder the other, the lower edges of the plates on the one side of the boiler and the upper on the other acting as fulcrums, in other cases the whole of the strain is thrown on the rivetting. Boilers made on this principle are never true circles, in which case the strain is unequal and is thrown on the joints, which have already been strained in bending. I believe furrows to originate from chemical agents acting on the edges of the plates, which combine with the bending of the plate and the sudden strains thrown on the boiler in forming furrows. In bending the plates the fibres of the inner edges become compressed, and in rivetting and caulking the concussion of the blows shakes and loosens the compressed fibres. When steam of any high pressure is in the boiler it throws a heavy tensile strain on the compressed fibres of the plate, which are released and again compressed as the boiler is worked. This continued action greatly assists the furrowing by forming cracks. Having been in use some time chemical agents, derived from the feed water, are lodged on the edges of the plates, at the already weakened joints: these agents gradually eat into the cracks, destroying the fibre and thereby throwing a greater strain on the remainder. These two actions, it will be seen, "play into one another," as I may express it, and thence follows the rapid production of furrows.

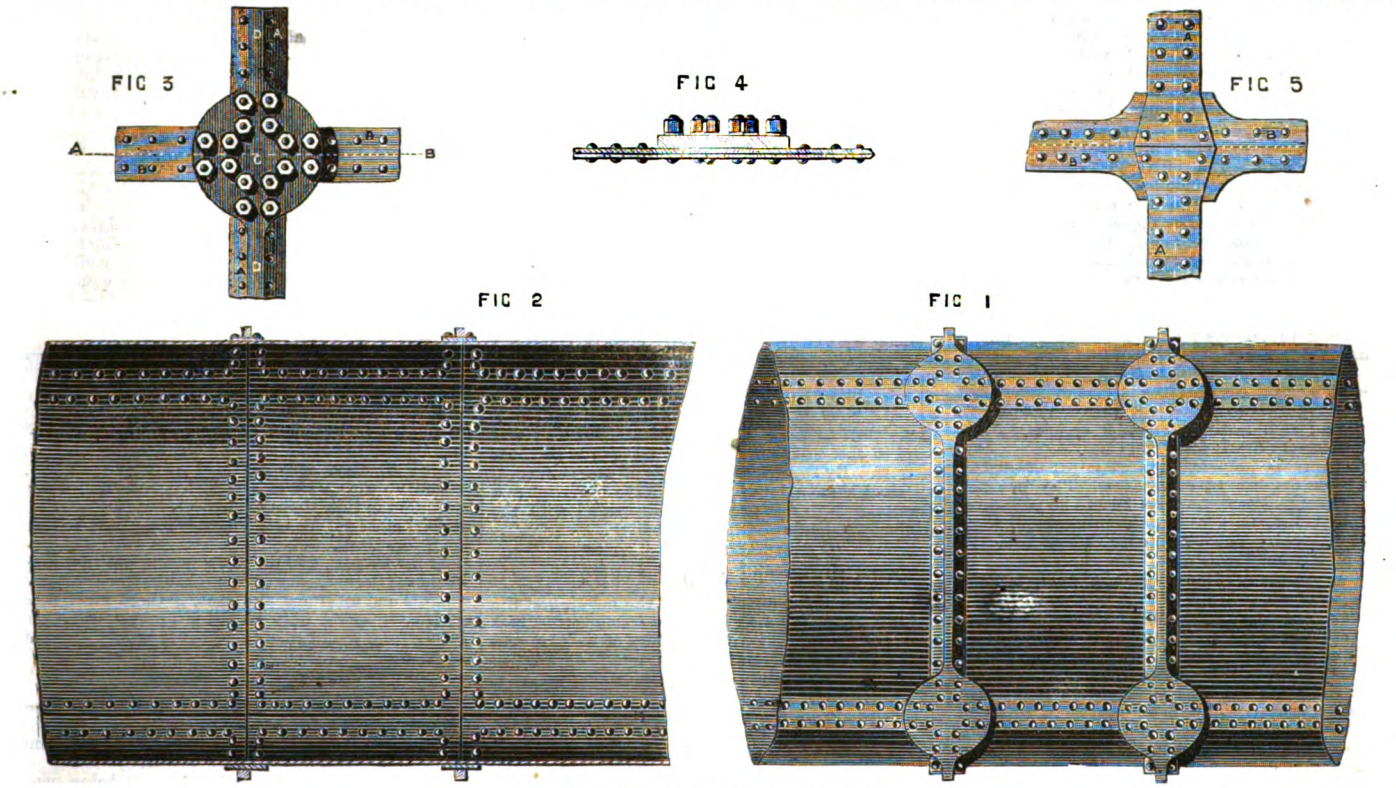
To illustrate this I will take the case of the boiler that exploded at Overton Station on the 30th of May, 1864, an account of which will be found in No. 8 of The English Mechanic in the article entitled "Wear and Tear of Boilers." It will be seen from the illustrations that the plate was furrowed principally on the top of the inside lap, and that "The boiler exploded just before leaving the station," when there was necessarily a greater strain on the plate from the steam being shut off. I attribute two-fifths of the damage to the chemical agents, for in boilers that have their plates cut at angles the plates have been found to last much longer, and to be nearly free from furrowing. It is obvious, then, that lap joints should not be used.

I here propose a form of boiler that would obviate these difficulties. The boiler must be made of any number of equal plates, two feet broad, and one-fourth of the circumference in length to make it the given size; these plates are arranged in such a manner that there will be but two longitudinal seams under water, as seen in Fig. 2, and are rivetted to flange-plates, the arrangement of which will be hereafter described, encircled; over these (Fig. 1) is a shrunk steel strap held in its position by a number of bolts. The arrangement of the flange plates will be seen in fig 5. A, A, are the plates encircling the boiler; B, B, the longtitudinal plates, the seams being shown in the dotted lines. The plates B, B, are tongued at their ends to enable them to receive the wedges cut on the plates A, A; over these the strap, D, D, is shrunk, and the plate C, which is forged on the strap, is fastened by bolts of the same size as the rivets, (fig 3).

Fig 1 is a longitudinal elevation; fig 2 is a longitudinal section; fig 3 is a plan of the strap and flange plates; fig 4 is a section of the same on the line A, B, and fig 5 is a plan of the flange plates with the strap removed. The drawings 1 and 2 are on the scale of 1 inch to the foot, and the drawings 3, 4, and 5, are made on the scale of 12-8ths to the foot. The same letters represent the same parts in all the figures. The advantages of this kind of boiler are: 1. there are no weakened joints, &c., from the bending of the plates. 2. The boiler being a true circle, the strain is equal and thrown on the flange plates, as will be hereafter described. 3. There are but two longitudinal seams under water, and therefore liable to chemical action. 4. The edges of the plates not being exposed, there is no space for the chemicals to rest upon. 5. If one side of a plate was furrowed, that plate could not give way, by reason of the flange plate and strap.

When the boilers expend from heat and pressure, a heavy tensile strain is thrown on the flange plates encircling the boiler, which tends to draw the wedges cut on their ends out of their sockets, thereby compressing the longitudinal plates as though they were strong springs. This strain is opposed, and thereby prevented from going beyond limits by the elasticity of the steel straps encircling the boilers; and is therefore divided equally on the steel strap, flange plates, and rivetting. Some boilers have their circumferences formed of a series of plates arranged in such a manner, that the greater number of their seams form irregular and disjointed lines beneath the surface of the water, which expose a large surface for the lodgment of deleterious chemicals. I therefore consider my arrangement better, for it is a true circle, and the strain is therefore equal. Further, only two long and regular longitudinal seams are exposed, which present no surface for the lodgment of chemicals. In most boilers of modern make, if one side of a plate becomes furrowed and gives way, an explosion is inevitable, but according to my plan it would not be so, for the boiler cannot explode unless the flange plates give way; this will be easily understood by reference to figs 1, 3, 4, from whence it will be seen that a plate may be completely furrowed at all its edges or cracked through its centre, but that it cannot give way without the flange plates and strap giving way likewise, or the plate completely bulging out, which is next to an impossibility. The strap and flange plates being subject only to external injury, they are not likely to be much damaged, and the joints will always leak when serious damage occurs, thereby giving due warning. The flues of the boilers must be made on the same principle, reversed.

Adrian Neison.



EXPLOSION OF STEAM BOILERS.

EMERY AND ITS PREPARATION.

Several correspondents having solicited information on this subject, we give them what we have to hand. In the ordinary preparation of emery the lumps of emery stone are broken up as if for macadamising. These broken lumps are then crushed under "stampers"—they being considered to leave the particles angular, which the "runners" do not. The coarse powder is then sifted through sieves of wire cloth, and the following are the numbers of wires usually contained in the sieves, and the kinds respectively produced by them:—16, corn emery; 24, coarse grinding do.; 36, grinding do.; 46, fine grinding do.; 53, super-grinding do.; 60, coarse flour do.; 70, flour do.; 80, fine flour do; 90, superfine flour do. No. 16 gives emery about the size of mustard seed. The sieves have sometimes 120 wires to the inch; the very fine sizes are more commonly sifted through lawn sieves; but the finest obtained is that which floats in the atmosphere, and is collected on shelves, &c., whence it is often gathered. Manufacturers rarely wash the emery, which is mostly done by the glass workers, and such as require a greater degree of precision than can be had by sifting.

In washing emery by hand, washing-over is a valuable application of the law of gravity. A portion of emery powder of uncertain size is thoroughly well mixed in a large quantity of water—as in a wash-hand basin, and in 10 seconds the liquid is poured off from the sediment which in that time has fallen. The bulk is again stirred and poured off at 10

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seconds, and this second sediment is added to the first—the process being repeated until no further sediment is deposited in 10 seconds. A fresh deposit is similarly collected from the residue after, say, 20 seconds, until the whole quantity of emery is divided into grains of so many sizes as may be required. The process requires a ready and steady hand. The following relates to twelve degrees of fineness in emery for the construction of machinery. No. 1, corn emery of commerce, prepared by sifting; No. 2, grinding, do.; No. 3, fine grinding, do.; No. 4, superfine grinding, do; No. 5, deposited at the end of 2 seconds; No. 6, 5 seconds; No. 7, 10 seconds; No. 8, 20 seconds; No. 9, 1 minute; No. 10, 3 minutes; No. 11, 15 minutes; No. 12, 1 hour. Sizes 5 to 12 should be kept in glass bottles, to keep foreign substances therefrom.

For emery for optical purposes, Mr. Ross mixed 4lbs. of the flour emery of commerce with 1 oz. of powdered gum arabic, which was placed in 2 gallons of clean water. The deposit was collected, as described, at the end of 10 seconds, 30 seconds, 2, 10, 20, and 60 minutes; and that not deposited at one hour's subsidence was rejected as useless for lens grinding. The gum arabic was recommended by Dr. Green for preparing red oxide of iron, for polishing specula.

In washing emery in the large way, the following method is adopted:—Twelve or more cylinders of sheet copper, 2 feet in height, and varying from 3, 5, 8, to 30 or 40 inches diameter, are placed exactly level, and communicating at their edges to each other by small channels, the largest vessel having a waste pipe at top. At the beginning of the operation, these cylinders are filled to the brim with clean water; the pulverized emery is then churned up with abundance of water in another vessel and run into the smallest (3 inch) cylinder, through a tube opposite to the gutter leading to the second cylinder. The water, in its passage across the 3 inch cylinder, deposits in that vessel such of the coarse emery as will not bear suspension for that limited time; the particles next in fineness are deposited in the second (5 inch) cylinder during the somewhat longer time the mixed stream takes in passing the brim of that vessel, and so on. Eventually, according to Holtzapffel, the water forms a languid eddy in the largest cylinder, and deposits the fine particles, till then remaining in supension; and, lastly, the water escapes by the waste pipe very nearly free from emery.

The paper is prepared like glass-paper, and of about six degrees of coarseness. The powders sifted through the sieves with 30 and 90 meshes to the inch being, in general, the coarsest and finest sizes employed. The cloth only differs from the paper in the employment of thin cloth instead of paper, as the material on which the emery is fixed by means of glue.

Emery paper is an article in which fine emery and glass are mixed with the paper pulp, and made into sheets as in ordinary paper. The emery and glass form about 60 per cent of the weight of the paper, which resembles drawing paper except that it has a delicate fawn colour. This paper is to be pasted or glued on a piece of wood, and, when rubbed with a little oil, to be used as a razor strop.

Emery cake consists of emery mixed with a little suet chopped small, rendered down, and mixed with a very little bees' wax, so as to constitute a solid lump, with which to dress the edge of buff and glaze wheels. The ingredients should be thoroughly incorporated by stirring the mixture whilst fluid; after which it is frequently poured into water, and thoroughly kneaded with the hand, and rolled into lumps before cooling. The emery cake is sometimes applied to the wheel while revolving; the more usual course is to stop the wheel, rub in the emery by hand—it is afterwards smoothed down by the thumb.

Emery sticks—more economical than paper wrapped round a file—are rods from 8 to 12 inches long, planed up square, or with one side rounded like the half-round file. Nails are driven into each end of the stick as tempering handles; it is then rubbed over with thin glue, and dabbed in all parts in a heap of emery powder, and knocked at one end to shake off the excess. Two coats of glue and emery are generally given.

(To be continued.)

In the year 1325 a vessel is recorded to have brought corn from France to Newcastle and to have returned laden with coal.

In 1740, the quantity of pig iron produced in Great Britain was 17,350 tons; in 1840, 1,248,781 tons; in 1863, 4,510,040 tons.

CHEMISTRY.

Preparation of Oxygen.—Mr. R. W. Artlect, writing to the *British Journal of Photography*, says:—"Having experimented on the valuable process for obtaining oxygen by the action of peroxide to cobalt on solution of hypochlorite of lime, with the view, among other things, of ascertaining what other substances might be possessed of the curious powers of the peroxide of cobalt. I have found that moist peroxide of iron or oxide of copper will answer the purpose. These substances, in the repeated trials I have made, have caused the evolution of a volume of oxygen equal to that obtained by means of the oxide of cobalt, and, like it, they lose none of their efficiency by use. The only difference I have observed is that, perhaps, the oxide of iron requires rather the highest heat to cause an equally rapid disengagement of gas. The oxide of copper answers perfectly, and if the oxide be not at hand, a few drops of nitrate of copper may be added to the hypochlorite of lime solution, and the gas will be given off abundantly immediately on the application of heat. I have also tried peroxide of manganese, but have not yet sufficiently investigated its action. I may, however, state that it does not accomplish the end in view so well as the other substances. The quantity of oxygen liberated is smaller, and permanganic acid is formed.'

Dr. Hofmann's "Introduction to Chemistry."—The new "Introduction to Chemistry, Experimental and Theoretic," which was announced last spring as in preparation by Dr. Hofmann will, we are informed, be issued in a few days. We hear that Dr. Hofmann has again availed himself of the colloboration of Mr. F. O. Ward, and in this work we may look for a scientific pendant to the admirable treatise on Applied Chemistry published by the same author as the "Report on Class II., Section A., of the International Exhibition." The lectures Dr. Hofmann delivered last spring at the Royal Institution constitute the framework of the book, which, in its expanded form, will present a full exposition of the new system of notation, and the modern doctrines of atomic and molecular construction. The subject is confessedly one full of obscurity, and to many the new doctrines are quite a sealed book. It is, therefore, a matter of congratulation that a profound chemist like Dr. Hofmann, and a luminous writer like Mr. F. O. Ward, have been engaged conjointly in the elucidation of the difficulties. We look forward to the publication of this treatise with great interest. By the kind permission of Dr. Hofmann, we shall shortly be enabled to give our readers a chapter or two of the contents, illustrated with the original woodcuts.

OUR WEIGHTS AND MEASURES.*

The committee appointed at the meeting of the British Association in 1863, to consider the best means of providing for a uniformity of weights and measures, with reference to the interests of science, has finished and printed its report, which was read at Birmingham.

In this report the committee observe, that they "have learnt that the metric system is already in use in many great establishments. Those especially who supply machinery to the continent of Europe are under the necessity of using the metric measurement in fulfilling their orders, and it does not appear that the workmen in such establishments have any difficulty in understanding the system, and in using it with as much readiness as the imperial scale." They also remark,—"Nowhere could we see more clearly the need of altering the present practice than in the practical routine work in railway management. With the enormous traffic of our railway companies, the inconvenience of the present subdivision of weights produces a decided appreciable loss to the income of the shareholders. . . . . It is calculated that on an average the clerks commit one error in every 500 items; and the consequence is that the London and North Western Company are under the necessity of nearly doubling the number of clerks. For every 100 clerks employed in weighing or measuring, and taxing packages, nearly another 100 are wanted to correct the errors committed. But with a decimal and metric system this liability to error is immensely reduced, and therefore a practical economic benefit would certainly arise from the adoption of that system in railway traffic. As a practical mode for diffusing information on the metric system, it has been suggested to fix the metric standards in one or more frequented places in the leading commercial cities of the empire." In conclusion the committee recommend "the reappointment of this committee, with power to use such measures as they may deem expedient for promoting the extensive use of the metric system in scientific and official documents in the Custom-house and Post-office, as well as the teaching of the system in schools and colleges; with instructions also as regards the coinage, to represent to Her Majesty's Government the expediency of the early adoption of such a system of decimalisation as will the more effectively facilitate the social and commercial transactions of the country, and at the same time advance the great purpose of international exchanges, and especially to urge upon Her Majesty's Government the great benefit that would arise from the early assembling of an international monetary convention, as recommended at the last meeting of the International Statistic Congress, held in Berlin."

Mr. F. P. Fellows read a paper "On the practical advantages of the metric system of weights and measures." The paper commenced by showing that the saving of figures to be written, and therefore of time, by the metric system of weights and measures over that of England is as six to one, and this merely in consequence of the decimalization of each unit of the metric system. Calculations were given to prove this. It next showed the great advantage this system offers, in consequence of its weight, measures of capacity, square, and cubic measure, being directly and decimally related to the measures of length and consequently to each other, giving practical examples to illustrate this. It then pointed out that the universally received English equivalent of the metre is incorrect, and gave the correct equivalent, and indicated how this error must prevent the adoption of the system in England for scientific investigations requiring great accuracy. Mr. Fellowes next drew attention to certain errors in the Government schedule or table of metric weights and measures attached to the Metric Weights and Measures Act, showing how those errors must prevent its safe use for trading purposes. He concluded by recommending the correction of the equivalent and the errors in the Government schedule before any further legal steps are taken to advance the system.

In connection with this subject, Professor Rogers said he did not desire that the working classes should be compelled by law to adopt it, but that it should be taught in all the National Schools, and that instruction in it should be included in the Oxford and Cambridge Middle Class School Examinations.

Lord Stanley, who presided over the section, wound up with a lot of second-hand matter, which amounted to this, that the advocates of the metrical method must not be in a hurry. They had a long job before them. They must first get people to consider the subject, and the more people did that they would see the necessity of some change in our present weights and measures, and that, if there must be a change, it could only be made in that direction. That reform would take time, but it would succeed in the end.

* Proceeding in Section for Economic Science and Statistics, British Association.

A Plain glass mirror reflects ·5352 of 1,000 rays—the quicksilver reflects two-thirds.

Spent tan is sometimes substituted, with excellent results, for charcoal in blasting powder.

A new rudder on Lumley's patent is being constructed for the screw troopship "Orontes," at Portmouth dockyard, and will be fitted to that vessel on her return to England from her present China voyage. The Lumley rudder, which is fitted to Her Majesty's ships "Columbine," "Scotia," and six other vessels in the navy, is one of the most simple yet efficient, forms of steering that can be applied to single screw ships, yet, strange to say, none of our large ironclads have yet been fitted with it.

We understand that there never was, more than now, a larger consumption of tin plates. Not only are most of the tin-plate workers who produce wares in common use very busy, but, on every hand, there is an extension of the use of this material for packing purposes. The large quantity of goods, of an edible kind in particular, which are now sent from the manufactories in canisters and boxes made of tin plates is something astonishing.

Glue for Cabinet-Makers.—Common glue, as used by cabinet-makers, is not always sufficiently strong to resist the strain to which the pieces joined together with it may happen to be exposed; sometimes even it is required to make metal, glass, or stone adhere strongly to the wood, in which case a mixture of glue and ashes will be found greatly preferable to glue in its ordinary state. The latter should first be reduced to the proper consistency required for wood, and a sufficient quantity of ashes added to give it the tenacity of a varnish. It must be applied hot.

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RECENT AMERICAN PATENTS.

Device for Reeling Cord.—This invention relates more particularly to an arrangement of mechanical devices to be applied to the handle portion of a fishing pole, either upon its inside or outside, for reeling the line, and consists principally in imparting to the spool or reel upon which the line is wound a reciprocating rectilinear movement, while at the same time it is revolved, whereby the line can be evenly wound, and with dispatch and facility. The operating devices for the spool are also so arranged that, when desired to unreel the line, they can be thrown out of gear, as it were, with the spool, leaving it independent of them, and free to revolve on its axis or shaft. The arrangement of this reeling device is simple and ingenious in many respects, and its operation quite free and accurate; and for the purpose for which it is especially intended it possesses many important advantages over the ordinary reeling devices now in common use for fishing poles. William M. Stuart, of New Jersey, is the inventor.

Fire Alarm.—This invention relates to an apparatus the operation of which is based upon the expansion and contraction of a spring composed of two different metals or other materials. The outer end of this spring is connected to an elbow lever, which is secured to a vertical arbor bearing an index, which traverses over an adjustable scale, and when the temperature rises beyond the desired point, said index, by coming in contact with the end of a lever, releases a tilting weight, and, by the action of this tilting weight, another similar weight is released, and thereby the escapement of a clock movement is freed, and said movement being driven by a weight or spring, causes a hammer to strike repeated and rapid blows on a bell, so that the attention of persons in the room, building, or other structure is called to the fact that the temperature has reached its maximum. The scale and spring are situated on a common bed-plate, and by adjusting this bed-plate the point, when the alarm is released, can be adjusted at pleasure. Charles Dion, Montreal, Canada, is the inventor.

Grease Cup.—This invention consists in the application of two valves, connected together by a jointed stem, which can be easily lengthened or shortened, in combination with two seats, one above and the other below the bulb or reservoir of the grease cup, in such a manner that, by turning the handle attached to the valve stem in one direction, the lower valve is closed and the upper valve opened ready to admit the lubricating material from the receiving cup into the bulb, and by turning said handle in the opposite direction, the upper valve is closed and the lower valve opened, and the interior of the bulb brought in communication with the steam cylinder or other device to be oiled. In order to allow the steam and air contained in the bulb to escape, when it is desired to introduce the lubricating material into the same, it is provided with a spring valve which will open by a slight pressure of the hand, and when released, close by the action of a spring combined with that of the steam in the interior of the bulb. Gebhard Hagenmeyer, of Big River, Cal., is the inventor.

Jar for Well-boring Tools.—In boring deep wells, such for instance as oil wells, a device is connected with the drill or drill rod to admit of the drill, in case of the latter becoming fast, being subjected to a series of blows or concussions in order to loosen it. This device, commonly termed a "jar," is indispensable in boring deep wells, owing to the great difficulty which would be otherwise experienced in withdrawing or loosening the auger. The ordinary jar in use is attended with some disadvantages. It is liable to get fast itself, and is subjected to considerable wear in consequence of being in contact with the grit in the wall of the well. It is also liable to break or give way when worn, and the withdrawing it from the well is attended with considerable difficulty; these advantages, it is believed, are fully obviated by this invention. Miles Joy, of West Greenville, Pa., is the inventor.

It might be supposed there was now little danger of the explosion of shells fired at the siege of Sebastapol and which had remained exposed ever since to the rains and snows of the Crimea; but the *Odessa Courier* says that accidents continue to occur from the bursting of such shells, and states a case of recent occurrence. Some boys found a shell in the neighbourhood of Bastion No. 4, and began to roll it in the direction of the town. It struck against a stone and instantly burst. Luckily no one was hurt, although one of the boys was so near the shell that his clothes were set on fire by the explosion.

NEW COAL-CUTTING MACHINERY.

Heretofore, when getting coal or other minerals by means of picks or cutters actuated by machinery, the cutters have been usually carried by trucks running on rails laid on the floor of the mine, along the front of the face of coal upon which the cutters are to be made to operate, and difficulty has been experienced in laying the rails securely, to prevent their shifting when the machine is at work. To improve upon this, Mr. G. Donisthorpe has patented an invention, according to which he employs posts and pillars, wedged or held between the floor or roof of the mine, to hold the rails in position, and prevent them shifting sideways away from the face of the work. The posts may be constructed in various ways to accomplish this object, but he prefers to make them capable of being elongated by means of a screw, and when using them holes are bored in the floor and roof to receive their upper and lower ends. In fixing such posts in holes previously bored to receive them, the lower end of the post would first be stepped into the hole in the floor, and the post then elongated, to cause its upper end to enter the hole in the roof; collars are placed on the posts near their upper and lower ends, and the screw is turned until these collars bear firmly against the floor and roof respectively; by these means the posts will be firmly held; the rails are by preference carried by transverse iron sleepers, having the chairs to receive the rails formed in one piece with them, and a post, such as above described, is placed opposite each sleeper at the end that is furthest from the work. The end of the sleeper is connected to the post at the requisite height from the floor, to bring the rails to the desired level, the post and sleeper being for this purpose suitably constructed to allow of the sleeper being connected to the post at any desired height. The end of the sleeper nearest to the work is packed or blocked up from the floor of the mine, to bring the inner rail to the correct level.

ORDNANCE AND TARGETS.

The Admiralty having erected a new target, representing a portion of the side of the *Hercules*, experiments were made at Shoeburyness which proved that a thickness of armour casing had been attained which afforded perfect security against even the largest guns recently constructed. The target has a facing of 9-inch armour-plates, and contains altogether 11 inches thickness of iron. Against this, three 12-ton shunt guns were fired, at a distance of only 200 yards, with charges varying from 45lb. to 60lb. of powder. One steel shot, of 300lb. weight, 10½ inches in diameter, fired with 60lb. of powder, at a velocity of 1,450 feet per second, barely broke through the armour, without injuring the backing. Sir William Armstrong has expressed his conviction, in the *Times*, that the 600-pounder gun will be unable to penetrate this target, and that it will, in fact require a gun carrying 120lb. of powder and steel shot to pierce this massive shield. Mr. W. C. Unwin has pointed out, in a letter to the *Engineer*, that for similar guns, with shot of similar form, and charges in a constant ratio to the weight of the shot, the velocity is nearly constant. Then, assuming the resistance of the plates to be as the squares of their thicknesses, it follows that when the diameter of the shot increases, as well as the thickness of the armour, the maximum thickness perforated will (by theory) vary as the cube root of the weight of the shot, or, in other words, as the calibre of the gun; and the weight of the shot necessary to penetrate different thicknesses of armour will be as the cubes of those thicknesses. The ratio deduced from the Shoeburyness experiments is somewhat less than this, being as the two-fifths power and the five-secondth power respectively. Practical formulæ deduced from experiments are given, which agree with Sir William Armstrong's conclusion, and prove that a gun which can effectively burn a charge of at least 100lb. of powder will be required to effectually penetrate the side of the *Hercules*.

Force exerted by Vegetable Growth.—Some idea may be formed of the force exerted by vegetable growth from the fact stated in reference to an enormous specimen, *Agaricus cartilagineus* (mushroom), which was sent to the British Museum. It was found growing below the pavement in the Goswell-road, and its *mycelium*, or filamentous body, from which this fungus growth is developed, which, in this case, was developed into an enormous spongy mass, had, in pushing up its many-headed pileus, raised a stone weighing two hundred weight, and measuring four feet square.

RANDOM NOTES.

M. Jeannel has discovered a new way of easily ascertaining whether there exists any lead in the tin used for tinning culinary vessels in hospitals. His method consists in this:—Take about five decigrams of scrapings of the metal to be tested, and boil it in an excess of nitric acid diluted with one-third of its weight of water. When the solution is complete, filter and then put in a crystal of iodide of potassium. If the liquid contains but a ten-thousandth part of lead, a yellow precipitate will be formed, which will not disappear by the addition of an excess of ammonia.

Experiments on the N. Y. Central railroad with peat show that 2,800lbs of peat will run an engine about 175 miles.

Colours on India-rubber.—The *Druggist's Circular* says:—"The surface of the object is covered over with a thick solution of caoutchouc in turpentine rubbed up with white zinc, and when this is thoroughly dried, the colour which it is desired to apply is put on mixed with turpentine.

Alum Bay Sand.—We are pleased to observe that the Alum Bay pits, from which the famous white sand for making glass is obtained, are once more in full work. A very large trade was formerly carried on with it by Messrs. Squire, who held the agency, but owing to various circumstances the demand fell off, and has been of late years almost nominal. An enterprising firm have now, however, taken a lease in it, and by the aid of tramroads laid down in the pits, and other modern improvements, a very large quantity can now be shipped in a short space of time. —*Hampshire Advertiser*.

One grain of gold will cover 52 square inches, or be 1,500 times thinner than writing paper.

Solid carbonic acid sinks the spirit thermometer to 162 deg. Fah. below zero in two minutes.

The German Ocean is 3 deg. colder in winter and 5 deg. warmer in summer than the Atlantic.

Both eyes make an object appear one-thirteenth brighter than when looked at with one eye.

The ascending power of a balloon with hydrogen gas to one filled with coal gas is as 15 to 11 nearly.

Gold leaf can be reduced to the 300-thousandth part of an inch; silver leaf to the 170-thousandth.

Gunpowder was first used in England for blasting in 1665, in Germany it was used as early as 1613.

The proportion of sulphur in the human hair is as follows:—Brown, 4·98; black, 4·85; red, 5·02; grey, 4·03. It is stated by some that the colouration of hair is due to the different proportions of sulphur it contains, by others to the presence of iron.

Euler determined the direct light of the sun to be equal to 6,500 candles, a foot distant; that of the moon to one candle 7½ft.; that of Jupiter, 1 at 1,320ft.; and Venus, 1 at 421ft.

The middle of the centre arch of Southwark Bridge rises one inch in the heat of summer, and the effects of a gleam of sunshine on the Britannia Bridge is immediately perceptible.

The manufacture of clasp knives was introduced into Sheffield in 1650, such knives having been previously known as joctelegs, from Jacques de Liege, a celebrated foreign cutler.

It is not generally known that lead is frequently attacked by a species of insects, the larvæ of which excavate circular passages in it. The insects do not eat the lead, but simply bore it out.

Of 10,000 rays of light only 8,123 reach the earth when the sun is vertical. 8,000 at 70 deg. high 7,624 at 50 deg., 7,237 at 40 deg., 5,474 at 20 deg. 3,149 at 10 deg., 1,201 at 5 deg., and 47 at 1 deg.

INDUSTRY AT WEDNESBURY.

Wednesbury is the principal seat of the manufacture of railway plant. Axles, wheels, and other descriptions of rolling stock, are made here in enormous quantities, one firm alone employing over 3,000 workpeople, and paying some £5,000 per fortnight in the shape of wages. Tubing is also an important department of manufacture here, being made most extensively for gas and water companies, and also for marine purposes. Wrought heavy ironwork, such as girders, boilers, tanks, and kindred articles, are produced in great quantities, as also is iron fencing. We have heard of a single order for the latter amounting to 600 miles for a railway abroad. India is becoming a vast and important market for these articles, and, great as the production now is, there is every promise of a still greater development of industry here. The miscellaneous branches of manufacture include foundry ware, wagon arms, engine fittings, and gun locks. Formerly pottery was one of the productions of Wednesbury, but that industry has altogether died out. About 10,000 persons are employed in the various manufacturing trades of the parish.

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THE ANGLO-FRENCH EXHIBITION.

The calls upon our space have been, and are such as to prevent our entering into detail concerning the great mass of objects on view; but we still have room to notice anything turning up of a character deserving of extra attention. We have now to notice a fine piece of wrought iron work by an English mechanic, named Lethwen, of Cheltenham. It is a bracket composed partly from one of the 16th century, and partly of the worker's design, and each piece is *welded* together, there being no brazing or soldering of any kind, nor is it much filed. He also exhibits another object—ivy leaves and berries. These latter are all forged, and their separate stems welded on to the stalks. The wonder is, how it could be done without burning them off. Our readers will do well to pay a visit to the Exhibition; with the thousands of other objects on view in the building the fare is low.

PATENT LIST.

(*From the Commissioners of Patents' Journal.*)

LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 30TH SEPTEMBER, 1865.

2741. Breech-loading fire-arms, J. Snider, jun—6d.
2742. Embossing or indenting paper, J. R. Crompton—8d.
2743. Weaving figured fabrics, D. Ellis and M. Hillas—1s. 4d.
2744. Springling liquids over wool, cloth, &c., M. J. Roberts—10d.
2745. Cotton gins, H. V. Scattergood—10d.
2746. Securing rivets and sheathing, G. Haseltine, 8d.
2747. Railway bars, girders, beams, joists, and angle irons, J. D. Young—4d.
2748. Non-conducting composition for preventing radiation A. Estourneaux and L. Beauchamps—4d.
2749. Distilling apparatus, F. H. Bickes—4d.
2750. Printing machines, G. Duncan—4d.
2751. Rotary engine pump or blast, W. Thrift—1s.
2752. Manufacture of oakum, D. Cullen—4d.
2753. Buffers, G. Simpson—8d.
2754. Hydraulic presses, A. Steven—4d.
2755. Cleansing grain, W. E. Gedge—4d.
2756. Packing, R. A. Brooman—6d.
2757. Filters, J. Slack—4d.
2758. Blowing cupolas, blast furnaces, &c., J. M. Stanley and J. Stanley—4d.
2759. Breech-loading fire-arms and cartridges, W. R. Newton and R. C. Shepard—1s. 6d.
2760. Hooped skirt, A. V. Newton—8d.
2761. Portable centrifugal pumps, C. T. Burgess—10d.
2762. Night lights, A. Field—6d.
2763. Guns and fire-arms, G. P. Harding, and T. Lynall—6d.
2764. Locomotive engines, &c., W. B. Adams—1s.
2765. Rack for holding blind cord, R. Montague—4d.
2766. Apparatus for drawing-off liquids, R. Rimmer—8d.
2767. Signalling on railways, J. Henshaw—4d.
2768. Grinding corn, J. Hurt and H. Tonge—4d.
2769. Stamping machine, L. C. Meaulle—1s.
2770. Obtaining power from liquids, C. Garton—8d.
2771. Raising screw propellers, W. K. Hall—6d.
2772. Rolling metals, A. Becham and H. Wedekind—1s. 2d.
2773. Treating yarns or threads and textile fabrics, J. H. Johnson—8d.
2774. Boots and shoes, J. Okey—4d.
2775. Chimney pots, J. Bell—4d.
2776. Extracting silver from lead, A. Moreau—4d.
2777. Breech-loading fire-arms and cartridges, S. Rydbeck—10d.
2778. Straw hats, J. D. Welch and A. P. Welch—4d.
2779. Motive power, G. B. Galloway—4d.
2780. Bill file, S. Dixon—1s. 4d.
2781. Construction of ships and vessels, J. Robinson—4d.
2782. Traps for drains, S. C. Reed—4d.
2783. Conveying sea water, J. Rae—4d.
2784. Gun barrels and ordnance, J. Thompson—4d.
2785. Colouring matters, J. Dale, H. Caro, and C. A. Martius—4d
2786. Filter or press, W. E. Newton—10d.
2787. Cap or stopper for bottles, F. Lane—4d.
2788. Collecting and treating night soil, J. A. Manning—4d.
2789. Injection for steam boilers, J. Robinson and J. Gresham—2s. 6d.
2790. Hats, caps, and bonnets, R. B. Cosley—4d.
2791. Lamp globe or shade, M. A. F. Mennons—4d.
2792. Steering apparatus, M. W. Ruthven—6d.
2793. Shaping and sharpening saws, E. J. W. Parnacott—1s. 4d.
2794. Preserving fresh meat, &c., J. McCall and B. G. Sloper—4d.
2795. Manufacture of pottery, &c., T. L. Boote and R. Boote—4d.
2796. Steam engines, &c., J. Simes—4d.
2797. Railways, H. Brockett—1s. 8d.
2798. Paper, L. Cooke—4d.
2799. Torpedo rams, G. A. Henty—4d.
2800. Copying drawings, &c., W. Willis—4d.
2801. Cement, W. L. Lees—4d.
2802. Mills for crushing sugar, G. Dixon—4d.
2803. Generating motive power, W. Clark—1s. 10d.
2804. Looms, W. Clark—10d.
2805. Cleaning forks and spoons, J. Cockshott—4d.
2806. Dessicating, G. Smith—10d.
2807. Moulds, J. Kinnibugh—10d.
2808. Sanatory toilet apparatus, W. E. Gedge—6d.
2809. Softening or deadening sound, F. Fearon—6d.
2810. Moulds, W. E. Gedge—4d.
2811. Developing heat, W. C. Thurgar and R. A. Ward—8d.
2812. Cages, C. Mohr and S. E. Smith—6d.
2813. Fog signals, E. Richardson—4d.
2814. Working ships' pumps, C. W. Heckethorn—4d.
2815. Washing machines, J. Thorne—8d.
2816. Compressing gunpowder for blasting, &c., H. Sutherland and E. Sutherland—8d.
2817. Sewing machines, J. Keats and W. S. Clark—1s.
2818. Knapsack supporter, G. Davies—4d.
2819. Carriage heads, C. Martin—1s.
2820. Closing envelopes and affixing stamps, W. Fisher—4d.
2821. Tonic malt liquors, F. A. Papps—4d.
2822. Sewing machines, J. McCloskey—4d.
2823. Whips, umbrellas, sticks, &c., C. S. Cadman—4d.
2824. Feeding millstones, E. F. Woods and J. S. Cockredge—4d.
2825. Preparing or dyeing wool and hair, H. W. Ripley—4d.
2826. Signalling in railway trains, C. Cotton and W. Nunn—4d
2827. Regulating the supply of gas, C. Esplin—4d.

THE METAL MARKETS.

Rails continue in great demand, and higher rates are not improbable; the makers are very full of orders, and each mail from America brings fresh business.

Copper.—More business doing; Burra £90, tough Cake, £85.

Tin in better request; Banca, £92, Fine Straits, £88 per ton.

Tin Plates on the advance; Coke, 23s. 6d., and Charcoal, 29s. per box.

Lead, more business. English £19, and soft Spanish £18 15s. per ton.

Spelter is quoted at £21 5s. on the spot, and £21 10s. to arrive.

FOR SALE, A Self-acting, Turning, and Screw-cutting Lathe. 10 inch centres, with bed 16 feet long; also a second-hand planing machine, to plane 4 feet by 2 feet. Apply to W. Blackett, Hope Iron Works, 106, Southwark-bridge-road, London.

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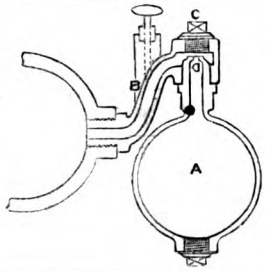

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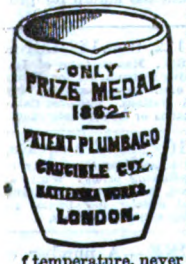

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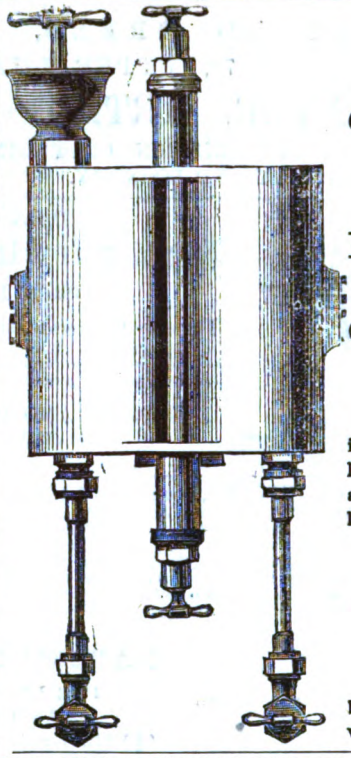

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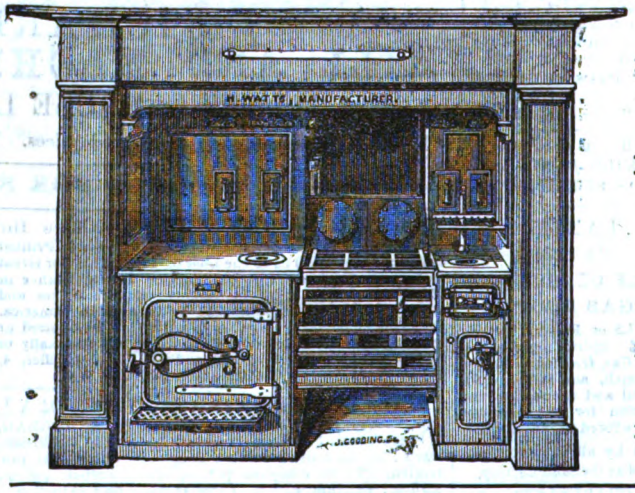

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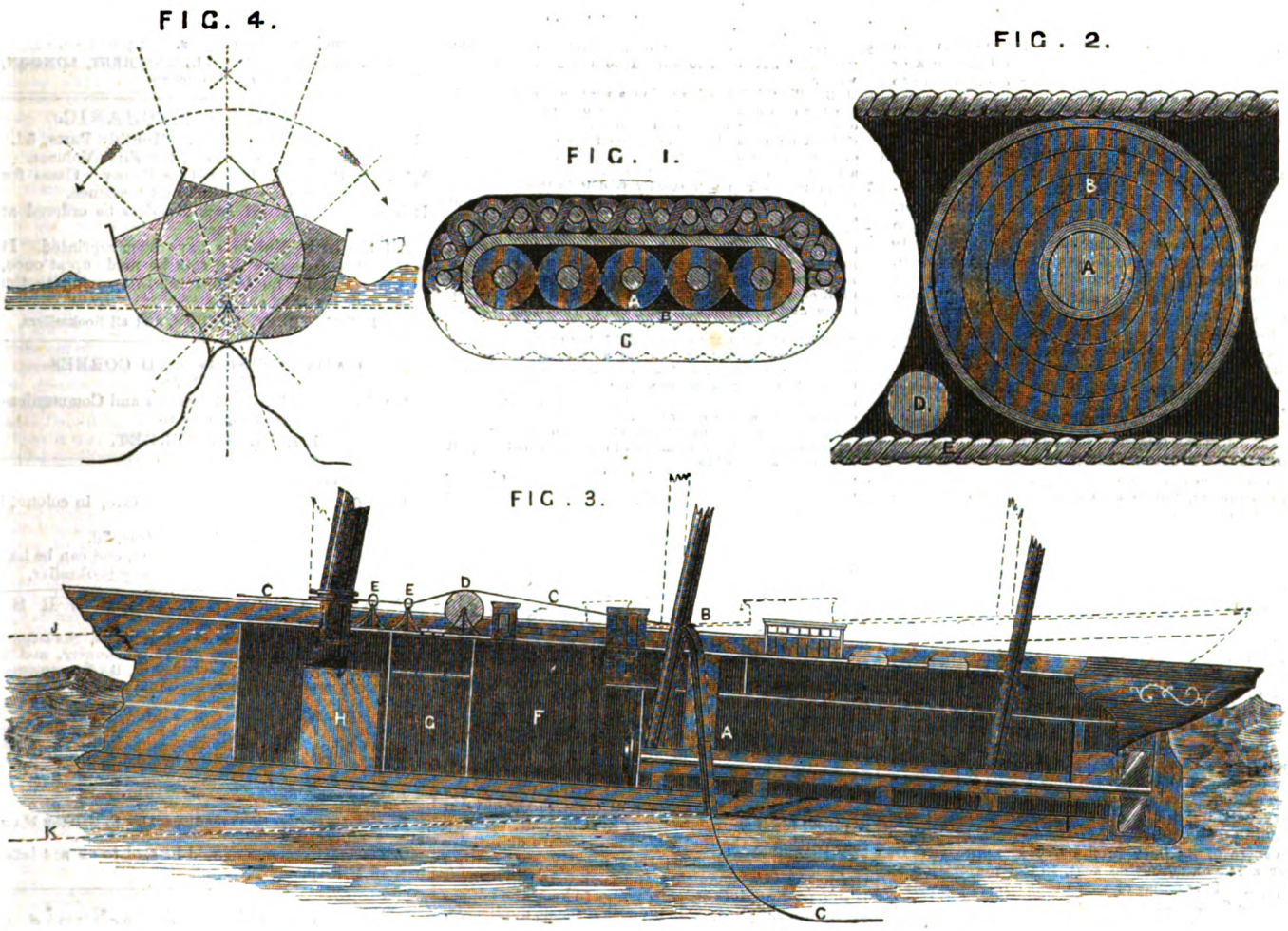

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OUR attention having been directed to Mulholland's improvements in the construction of deep-sea telegraph cables, and method of laying same, and knowing the vast amount of interest attaching to the subject, we this week take the opportunity of calling attention to the matter.

To briefly, yet distinctly, point out the main characteristics of Mr. Mulholland's invention, it is necessary to refer to the engraving, in which Fig. 1 is a full size transverse section of a 5-core cable: A, representing one of the insulated conductors; B, the fibrous or green hide, serving or braiding over same; and C, the wire sheathing or external protective envelope. This diagram explains the arrangement of the several parts and method of construction, the patentee's object being to combine any number of conductors in a flat rope, the selection of form being governed by the admitted superiority of that shape for mining purposes, both as regards the additional strength gained and great saving of expense in manufacture, combined with durability, superior lightness, and capability of withstanding strains. Hence, it appears that by preferentially adopting the form of a flat instead of round rope, it is practicable to construct a cable which it is claimed is superior, both mechanically and electrically, to that recently lost, and admitting the cost of laying to be the same (although such would not be the case, as no brake machinery is repuired, and the method of paying out or hauling in essentially different to those hitherto practised in submerging cables in deep water *without injury to the insulation*), claim that sixty instead of twelve words can be signalled per minute, must unquestionably interest intending shareholders, in any scheme of transatlantic telegraphic communication. Fig. 2 shows a single conductor in section *enlarged* five times. A is a chemically pure copper wire, varying from 12 to 16 B.W.G. (according to circumstances), the surface being carefully deoxidised before coating with an insulating compound; B, *pure* india-rubber tape, immersed in phosphorised composition, wound tightly round the wire and passed through shaping rollers to ensure uniformity of size and homogenity of the several parts (this process of manufacture causing the layers of caoutchouc to adhere to the already insulated conductor); C, two or more coatings of composition laid on at intervals to ensure perfect insulation; D, special compound of non-conducting material uniting the several cores; E, protective braiding o hemp or green hide, saturated with the composition, and shaped in rollers prior to receiving the wire sheathing. The cable, on completion, and previous to being stowed for service, is passed slowly through troughs of the composition to prevent oxidation of the wires, and (as the compound acts in a few minutes) it receives a final coating immediately prior to immersion. Fig. 3 is a longitudinal section of the after part of a vessel assumed to be specially fitted for telegraphic purposes; A, centre of gravity; B, a water-tight sheath or tube over an opening cut through the bottom of the ship, as near the kelson as possible; C, C, C, the cable; D, a drum or whimsey on the upper deck, being the *point of contact upon which the cable impinges* on its road to the delivery tube; E, E, guide rollers, fitted with lever nippers (not shown) to retard the delivery of cable if necessary while paying out; F, engine room; G, coal bunkers; H, boiler room; J, upper deck; and K, line of keel when vessel is pitching by the head. Fig. 4, represents the midship section of a ship rolling to port or starboard in a heavy

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seaway, showing the centre of gravity at A and the cable B, B, paying itself out under any circumstances in still water, while the vessel is running at full speed under sail or steam, or both combined.

It is admittedly sometimes a more fatal mistake to underrate than to over estimate the merits of any particular invention, and finding as noticed by us in No. 10, Vol I., that a patent has recently been taken out in Paris, (and the discovery highly eulogised by the continental press) for the application of phosphorus as a preservative "from the attacks of those agents that ordinarily effect the destruction of iron," we must in this particular instance admit our countryman's claim to priority of invention, his patent being dated September 1863. It appears that in the South Atlantic and Pacific Oceans vast submarine forests of the "Fucus maximus" are met with growing from insignificantly sized rootlets at depths of 70 and even 100 fathoms with straight smooth stems 1 to 1½in. in diameter until they reach the surface, and these are invariably so strong and pliant that they resist with impunity the action of the mightiest breakers in the world. Observation revealing the fact that neither Remora Crustacea or animalcula of any kind penetrate or even adhere to the polished exteriors of these singular vegetable ropes, and subsequent analysis proving incontrovertibly the ashes of the Fucus in question to be unusually rich in phosphoric acid. The patentee claims to have discovered a chemical agent not subject to decomposition by organic or inorganic matter, therefore a true preservative from the action of sea water. Hence the origin of the compounds, the application of which the inventor advocates as protectives to metal and timber from marine or atmospheric action, and consequently from the amount of constituent phosphorus they contain to be peculiarly adaptable for submarine telegraphic purposes generally when combined with carefully selected materials to insure homogeneity and durability, objects of paramount importance and consideration evidenced by the care bestowed upon the drawing of the patent specification.

AMERICAN PATENTS.

Combined Friction Wheel and Oil Chamber.—This invention is more especially intended for railroad car brakes, but is also applicable to other machinery to which power is transmitted through the medium of a friction wheel. It consists in combining with a friction wheel an oil chamber arranged in such a manner that the former will always be kept in a perfect state of lubrication, the importance of which, in connection with a friction wheel for transmitting power, may be easily imagined. A. I. Ambler, of Chicago, Ill., is the inventor.

Steam Trap.—The object of this invention has been to make a steam-trap for the discharge of the water of condensation from steam pipes and vessels, automatic under all circumstances and of the utmost simplicity in its construction. The water is received in a metallic casing through the bottom of which is passed a pipe closed at its top and perforated with a series of holes at a small distance above the bottom of the casing. An open vessel, in shape like an ordinary pail, but having a collar fitting around and extending a short distance above an opening through the centre of its bottom, fits over the pipe, and its collar acts as a moveable seat, to the perforation in the pipe. This collar or valve seat covers the valves when the float is at rest, and uncovers them when it is in motion, so as to discharge the water. Peter Hogg, of New York City, is the inventor.

Oil Ejector.—This invention consists in closing the bottom of a well tube in which an oil ejector is used, and placing a valve therein below the embouchure of the ejector. The effect of this construction is to prevent the pressure of the currents of fluid or liquid delivered into the tube from the ejector from acting upon the gaseous or liquid contents of the well, and so to relieve the packing and also the gases and liquids in the surrounding rock from such pressure. By means of this invention the whole energy of the currents which pass through the ejector is used directly to lift the columns of gases and liquids in the well tube, and none of it is allowed to react against the packing or against the incoming oil and gases. F. S. Pease, of Buffalo, N. Y., is the inventor.

Baron Sequier has discovered that if a glass cylinder is plunged vertically into a vessel of water in such a way that a part of it will be in and a part above the water, and a ball of lead is allowed to fall within it, along its axis, the glass will be cut horizontally on a level with the surface of the water, the part below being broken in pieces longitudinally. The effect is due to the incompressibility of the water.

ANSWERS TO CORRESPONDENTS.

B. C. E. (Dowlais).—Send for Spon's catalogue, and you can select therefrom to suit your pocket.

Gregorious.—Yes, you can get all in, easily—but, be careful. (2.) Not wanted in Provisional, but mechanical drawings required with Complete: must, in your case. We wish you every success.

G. F. W. (Liverpool).—Notice partially withdrawn.

R. S.—We will try what we can to oblige you.

Indicator.—Spon publishes a book at 4s., by Main and Brown, on the "Indicator and Dynamometer, with their Practical Application to the Steam Engine." Also, one by C. T. Porter, price 2s.

T. Holroyd.—There is no special work that we know of, but we have inserted your query elsewhere. (2). "Heat," by Colburn, 2s., Spon; Scott Russell, on the "Nature, Properties, and Application of Steam," 2s., Spon. Also, a work in two vols, by C. W. Williams, on "Steam and its Production," which Spon could furnish you with, doubtless.

A. W. Forbes (Edinburgh).—Received. Best thanks; the subject is pretty well known, and we believe there are several patents out for it.

P. P.—Received. Would advise you not to waste your time. Wait till the circle is squared.

Sheffield.—Your complaint of not having received the "Guide" has been forwarded to the address of the writer.

S. J. B.—We think the invention a very good one—especially the grip and leverage. Try the one or two makers of cables—whose address in London Directory; if that will not do, try and get an opinion from one or two men of science, and with them in hand, advertise a little for a capitalist to purchase the patent.

Telegraphic.—You will readily find it in the Post-office Directory at your coffee-shop. We think he may be found at the works at Greenwich.

James Brown.—Many thanks for your kind letter. The title cannot now be altered, as you say—but what's in a name? We have put a "query" in for you, in its place. Perpetual motion is fudge, and we have stopped communications; anyone striving after it simply wastes brain, tissue, and time. Send us up your wood-cutting scheme.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

THE WILSON FURNACE.

The object of this furnace is a saving of fuel and the consumption of smoke; and it is attained by—contrary to the usual practice—burning the fuel downwards or inwards, instead of from the lower surface upwards. For this purpose furnace-bars are dispensed with; and, instead of the usual feed door, there is an aperture at the top of the furnace, through which alone both the fuel and air are supplied, and which can be easily opened or closed, as may be found requisite. The coal, which is in small pieces, falls from the opening along a curved inclined plane, descending according as the lower portion is consumed. The volatile products given off by the heated coal are carried down, along with the oxygen required for their combustion, by the draft, through that portion of the fuel which is in a state of intense ignition, and consumed; thus greatly augmenting the heat and economising the fuel. As the furnace is self-feeding, it is only necessary to keep the hopper at the top supplied. The invention seems applicable, at a small cost, to existing furnaces, &c.

Tin Plate Poisonous.—It is usually believed that the tin with which the sheet iron used in saucepans and other domestic utensils are covered is harmless; and that what is employed as a coating for copper vessels is not only an absolute protection against the dangerous properties of the copper, but is itself a perfectly harmless addition. Such was the case formerly, but to suppose it so at present would be a dangerous mistake. In this time of violent competition among manufacturers, and unbounded desire of gain, no mode of adulteration, however mischievous to the consumer, is considered culpable, provided it increases the profit of the seller. Lead, as is well known, is capable of giving rise to the most deleterious compounds; and, unfortunately, cases of lead poisoning have frequently occurred of late from the use of tinned tea-kettles and saucepans. This arises from the tin used in coating the sheet iron having been largely mixed with lead, a far cheaper metal—an adulteration of tin which is extremely common. The fact will, when generally known, lead to the more general use of enamelled articles; especially when substances containing constituents likely to act on metals are to be heated in them.

NOTICE TO ADVERTISERS.

Advertisers in this journal are respectfully informed that the Collector from the office, 162, Fleet-street, will call upon them for a settlement of the amounts due for the insertion of advertisements. The Collector will in every instance hand in a printed receipt for the sum paid to him. Advertisers are particularly cautioned against paying money without receiving the printed receipt.

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The English Mechanic.

FRIDAY, OCTOBER 20th, 1865.

TRADES UNIONS AT THE SOCIAL SCIENCE CONGRESS.

As might have been expected, the subject of trades unions and strikes occupied no inconsiderable share of attention in Sheffield during the recent Congress, and it was led off in the Department of Economy and Trade by Mr. Wilson, a pen-grinder, with a paper entitled, "On Tradesmen's Strikes and Lock-outs, and Courts of Arbitration and Conciliation." He commenced by pointing out that close combinations maintained a high rate of wages, and because this was done on a limited scale the unionists believed that it could be accomplished universally; but the unionists only succeeded by restricting their number; and this view was taken by Mr. Stuart Mill. He argued that the system of restricting employers from taking more than a certain number of apprentices prevented a father from putting his son to a trade better than his own. Some trades were better suited for successful combinations than others, and high wages were obtained; but if the men were not allowed to compete

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in the best paid trades they were driven to the worst, in which trades consequently wages remained at starvation point. After quoting extensively from Mr. Stuart Mill, Mr. Wilson went on to point out that labour was an operation, a power directed by a design, and perfected by moral culture and intellectual study. No one wanted to purchase the labour, but its product; and after selling the "product" a man retained his labour. He then reviewed recent strikes and their causes, and said that in all those cases the men were met by lockouts, and the capitalists were successful and the men suffered. To obviate this state of chronic antagonism between different trades, he believed courts of arbitration were impracticable. He believed trades unions and strikes would work their own cure. He did not remember two strikes in any one trade, as, by suffering, men learned wisdom. The men were in favour of arbitration courts; but surely if a man could sell a pig, or the produce of his garden, or had the choice of a wife, he could sell his labour without the interference of third parties. The right of buyers and sellers was to be free, and what could compulsory arbitration do unless they could compel men to employ their capital in a particular way? No court could be as successful as a settlement between the masters and men themselves. A strike and lock-out placed both parties in a false position, as neither party could act without consulting the executive committees, which frequently prevented a settlement between the master and men; and the doctrine of non-intervention proved the true one. Men had a perfect right to combine, but not to coerce those who did not join the combination.

Mr. Wilson made one or two good "points," but did not seem to carry his audience well with him.

Mr. Frederick Hill said that whatever faults might have been committed by the working classes they were not alone in the matter, for all concerned in the legislation of the country must take upon themselves no inconsiderable share of the fault which had led to such disastrous consequences as those which had taken place.

Mr. Dronfield, an operative, expressed his belief that, as it was very easy to throw dirt, so abuse had been heaped pell-mell on Unions, and their members. He called attention to the state of the law which made it an offence punishable by imprisonment for a man to break his contract, whereas, if the employer broke his, he was only liable to a civil action. Trades unions, he said, did not devote all their energies to stirring up disturbances and keeping up strikes, and instanced the many benefits accruing to their members in libraries, unemployed money, and funds to meet sickness and death. It was seldom, he said, that a member of a trades union had to seek parochial relief. Professor Fawcett, M.P., thought working men had a most undisputed right to combine, if they could support that combination without practising coercion. In consequence of the existing economic relations between the labourer and the employer not being satisfactory, these combinations were necessary, presuming there was no coercion, in order to give the labourer the greatest possible price which he could obtain for his labour. By joining and combining, artisans were more likely to get a satisfactory bargain than they would if they did not combine. But let not labourers make any mistake about what they could obtain by these combinations. Unjust demands had been made upon the masters in some cases, but whatever injury was thereby inflicted upon the masters the injury falling on the working men was greater. Therefore the justice of the cause should be well ascertained before combinations were organised.

Amongst other gentlemen who took part in the discussion were Mr. David Chadwick, Mr. Edwin Chadwick, Mr. Channing, and others. Mr. Thomas Hughes, M.P., was to have taken part in the discussion in this department, but he was unable from some cause to be present.

At the working men's gathering on Thursday evening three of the speeches were of special interest, from the fact that the speakers were all young members of the Parliament just elected, owing their election in some measure to the favour of working men. Their remarks, therefore, might fairly be regarded as indicating by anticipation the course which, on particular questions, they were likely to adopt in the House of Commons. Mr. Chambers spoke with the earnestness and fluency which secure for his remarks a favourable hearing from public assemblies, and, insisting on the advantages of education, he so adapted his arguments and illustrations to the audience he was addressing that at every few sentences he was interrupted by their acclamations. Mr. Hughes marked out for himself a different line, running *contrá* to the feelings of his auditory in a very remarkable manner, and to an extent that required, even from him, no ordinary amount of daring. Speaking in the very central district and stronghold of trades unions, he did not shrink from using such language as the following:—

"The difficulty which had stood in his way was that this had been constantly thrown in his teeth—'Oh, have you heard of the last trade outrage in Sheffield? Have you heard that a house has been blown up with gunpowder, and that another man's wife and child had been attacked because he did not ——. Did not what? 'Because he did not obey the laws of a union of which he was not even a member?' If trades unions were to fight the battle of the working men they must set their faces against practices such as this. Let them say, 'These outrages are things of the past; in the future you shall hear no more of them; we shall fight our battles henceforth in an honourable, straightforward, and Christian manner.' He had heard a few things of Sheffield. The men of this town lived in the very heart, in the midst of the intelligence of England, and as working men they received the highest rate of wages, and yet he was told they were opposed to the introduction of machinery, whereby they were driving away from the town a large branch of industry for which they had been celebrated for hundreds of years. (General cries of 'No, no,' and 'Order.') Well, he was brought up in an agricultural district, and was just old enough to remember the machine breaking which took place in that part of the country. Those acts of folly produced a sad amount of destitution and misery; but by-and-bye the men found out their mistake, and now there were reaping machines and thrashing-machines working all through the district, and what was the result? That wages had risen 50 per cent. since the introduction of machinery. He would warn the men of Sheffield, if they were opposed to machinery, that there could be only one result—that they would drive the industry of the town into towns where the men were not so short-sighted.

"He heard that there were rests used, the use of which was enforced by the trade, but the effect of which was to double up the man's arm and make it useless after a few years, while they had a rest which produced no such results, and which, if used, would enable a man to work ten, fifteen, or twenty years longer. If that were not true, let them contradict it. To his mind it was necessary that he should in this great centre of trades unions, where they had it nearly all their own way, tell them the plain truth; and in so doing he repeated, with regard to machinery, that if what he had heard were true, they had adopted a course by which they would gradually lose the confidence of the best part of their fellow-countrymen, and by which they would not hold their own in the great industrial race of the country, unless the men confined trades unions to laying down laws for their own members, and did not meddle with those outside."

The delivery of these sentences coming, above all, from the quarter from which they proceeded, exercised an effect upon the body of the assembly very much as if a live shell had dropped into their midst.

The speech immediately following that of Mr. Hughes was in very different tone and temper. This was delivered by Professor Fawcett, who apparently thinking that the working men required some soothing words after what had just been said in their presence, entered upon a glowing description of what the condition of the workman should be as distinguished from what it is. The speech was able, fluent, adapted in most respects to the taste and peculiarly to the prejudices of the class to whom it was intended, but it is doing no injustice to Professor Fawcett to add that in the opinion of warm friends of the Association, even of his own, the power for good of Social Science Congresses would soon be at an end if such harangues to the operative classes were habitually indulged in from these annual platforms.

Mr. J. Chubb has just invented a method of securing safe doors from the application of the professional burglar's wedge. The frame, in place of being made flush as hitherto, projects beyond the door, so that the door will be recessed; and further, to protect the door and the keyhole or holes through the door of a strong room or iron safe, a hardened steel bar is applied externally to the door, and from side to side thereof, the bar being fitted within a groove across the door. This bar is of a curved convex form externally, and flat on the side where it comes next the door. At each side of the framing of the door a projecting socket is formed, into which the bar slides after the door has been shut and fastened or locked. In order better to insure that no thin steel wedges shall be introduced, the sides of the groove across the door in which the bar is fitted are under cut.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

EXPLOSIONS IN STEAM BOILERS.

Sir,—A subscriber from the first I have been, and hope still to be, delighted with my weekly pennyworth—The English Mechanic. I am only a stoker, but I can understand a great deal of what is set before me in your paper, by yourself and your correspondents, whom I have had to thank for information once or twice There is one correspondent who signs himself "F. M," a new member of the "Correspondence Club," who, in my opinion—if that is worth anything—had better leave off writing on boilers until he knows something about them. His writing is "one of the things no fellow (in my line) understand;" and I don't think he's too sure about it himself.

I always notice that the less a man knows about a thing, in which he would like to dabble, the more he goes "supposing" and "guessing," and making what he is pleased to call "theory" do duty for "practice." I don't say "F. M." does this; but what he does is very like it. He says that the majority of explosions are shrouded in mystery. Well, if he writes of the appearances their particulars present to himself I am not qualified to doubt, but if he thinks to express my opinion in his declaration, I can tell him he is—well, he is utterly wrong I am no better informed, perhaps, than many other stokers, and yet I don't remember ever having heard of an explosion which could not be accounted for, if the parties "interested" would only speak out. Now, down here, we have the Steam Boiler Association, and Mr. Fletcher never experiences any difficulty in giving a "why" or a "wherefore" in every case submitted to him; and that being the case, it is evident to any thinking man that such explosions are preventible; consequently, that what they are shrouded in at the time of an explosion is not mystery by a long chalk.

More than that, it is shown by the officers of the Association, and by the boilers they look after, that there is no mystery in the matter, and that care and attention are the only things necessary to keep a boiler in long life.

If "F. M." will get hold of the reports of this Association he will find everything very clearly accounted for; and he ought to know that a coroner's inquest is scarcely the place in which to find light thrown on a subject, constituted as some of these assemblies are. "F. M." has not asked for any information on the subject, but in case he should, I would ask him to canvass among the shops here for the opinions of stokers and engineers. I am sure he would think twice after that before he thought of asking you for more room, and to be put in big type.

I can't say I've studied the growth of steam over a fire; and perhaps "Mr F. M" is right in what he says about that. I have heard before that perhaps gas from the exterior could penetrate the boiler shell, and give fits to its contents; this I should imagine could be done by subjecting it to a terrific pressure; but as this is not done in daily practice, I fancy that any gas which may penetrate to the outside of a boiler is rapidly driven away again, up aloft, or drawn by draught under the bars, through the fire, and turned into the air as something else. But, there, I'm almost getting as—as shrouded in mystery as "F. M," who takes longer in working to a point than did another "F. M."—"The Duke;" and therefore I will leave off, as my "turn" at stoking begins shortly. And I'm only repeating what my mate and the other "shift" say, when I express to you the hope that the next correspondent who lays hold of a boiler for a subject will be careful what he is about, and not subject himself to a "blow up," though, mayhap, he might see a "flash of lightning" during the operation.

H. Reynolds.

Manchester, October 7, 1865.

[Our correspondent will observe that we have struck out a considerable portion of his letter, including the "personal" matter. Such cannot be allowed entry into our columns; and has never yet advanced a discussion one step in the right direction.—Ed. E. M.]

BOOKS ON TURNING.

Sir,—Allow me to express the gratification I have derived from perusing the list of "Books on Turning," by "H. H." in your paper of Oct. 6th, a list I have long sought for in vain. I heartily wish that some competent person would take the hint dropped by "H. H.," and compile a work on Turning "worthy of being reckoned as the continuation of Holtzapffel's great work." It is a reproach to a country like England where the mechanical arts have attained unrivalled perfection, that at the present time we are positively without a good English book on plain and fancy turning. From my knowledge of the English works on turning, I am able fully to endorse the strictures which "H. H." makes regarding most of them. Some of the French works are far superior to anything published in this country, but it is evident that the language in which they are written will be an effectual barrier to their general use in England.

I sincerely hope that among your numerous and talented contributors there may be some gentlemen able and willing to compile a work on turning, such as Charles Holtzapffel would have written had his valuable life been spared. Perhaps "H. H." himself would undertake the task, but by whomsoever undertaken it should be regarded as a "labour of love."

A book worthy of the subject would be hailed with delight by thousands of turners, and especially so by S. H.

P.S. Will "H. H." kindly furnish me with the price of Captain James Ash's work on turning, numbered 26 in the list, and also the address of L. Booth, the publisher.

ECCENTRIC CHUCK.

Sir,—I observe that some of your correspondent amateurs want to make an eccentric chuck. Some years ago when making amateurs apparatus I made an improved chuck that would either do for an oval or eccentric one.

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A tracing of the drawing of this chuck I will present to any mechanical amateur, or you may insert it in your magazine if you think it worth your while.

Wm. Muir.

[We shall feel greatly obliged if our correspondent will forward the tracing to us.—Ed. E. M.]

OUR SUBSCRIBERS' NOTES AND QUERIES.

Sawing Timber.—Where can I, in London, or close to it, see a machine for sawing timber driven by horse-power?—M. Williams.

Electric Light.—Will any one tell me how I can get a steady light of this character?—Millwall.

Oil Gilding.—Wanted to know, the best method of oil gilding on wood and iron.—J. S. G.

Blacking Sheet Tin.—How can I best bronze or varnish sheet tin black so it wont rub off?—V. V. E.

Lathe for Nails.—Wanted: a description of a lathe for making small screw nails for iron?—Mechanic.

Flues.—I want to make a zinc pan 18 inches deep, 3 feet over at top, 8 inches at bottom, to be made in three pieces—wanted, the rule for cutting it.—Hand Chisel.

Spoiling Tools.—How is it that, when repairing cast-steel tools, if heated above a dull red heat, they are spoilt, though they have previously been exposed to almost a melting heat?—H C.

Oil for Clocks.—Which is the best, and how is it refined?—E. Feather.

Coils, &c.—The best place to buy copper wire, also the silk used in constructing electrical machines? What conditions must be observed in covering the wire, and why it must be covered? Must secondary coils as well as primary ones be covered? This for a guide in constructing a covering machine.—T. Parker.

Perspective.—The best method of finding the point of sight and the perspective plane, or plane of delineation in perspective, and also the best position for the point of sight on the drawing?—A Sub.

"Spiritual" Mechanics.—J. B. (Glasgow), wishes information respecting the *modus operandi* of the so-called spirit-rappers, including the Davenports and Mr. Home. He thinks a diffusion of knowledge on this subject would tend to good.

Magnesium.—Can any one tell me of a book on magnesium, its nature, properties, and appliances?—T. Holroyd.

Water Power.—Can any one inform me by what mechanical means a fall of water, seven feet, running at fifteen gallons per minute, can be made to raise a column of water in a ¾-inch pipe to a height of twenty yards?—Fred.

Friction Gearing.—Can any one inform me of a good plan of friction gear to wind both ways with engine running—the gear to be put in and out as required?—C. E. A. (Sheffield).

[We think a Glasgow firm supplies this on their own patent—Robertson and Company, we think, but are not sure.]

Pump.—The cheapest way of making a force pump for an ordinary-sized garden engine—length of stroke and diameters of cylinder and valve.—C. R Finch.

Density of Earth.—Can any one give me the formula for finding the mean density of the earth by means of the number of vibrations which a pendulum makes in a given time.—W. H. E. Richards, (*alias* Round Head).

[Here let me thank Mr. Parkinson for his kind offer. Mr. Hart, of Edinburgh, has kindly supplied my wants.]

Belting.—Where can I get machine belting ¾ inch wide that will remain flexible, and the cost?—Pneumatic.

Screw Threads.—Is there any difference as to power in screws of one thread only, and those of same diameter and pitch, but with two or more threads?—Tyro.

Falling Force.—A steam hammer weighing 5 cwt. falls through 20 inches its own weight; what is the amount of force or weight impacted on the object operated on, and what amount of dead weight pressure would do the same?—T. Y.

Nails.—Who makes machines for making iron wire nails, such as made and used on the Continent?—R. O.

Microscope Lens.—Will any of your readers inform me how microscope lens are ground, polished, and centered?—D. K

Speculum.—I have a 4 inch Gregorian speculum, whose figure I fear I injured by attempting to polish it in a common turner's lathe. Its focal length is about 23 inches, with its ordinary little speculum. Can you guide me to a practical workman who could restore its figure and polish?—G. B. G.

I should be extremely obliged if your correspondent "H. H." would inform me through the medium of your valuable paper, the price of the two volumes and atlas of "Bergeron's Manuel de Tourneur," and also what English bookseller would supply it?—J.F.

PENDULUM.

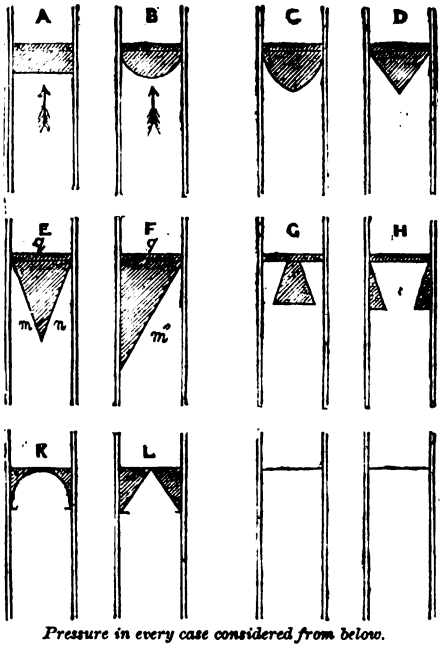
Sir,—In No. 26, "J. Newton" enquires what keeps the pendulum of an electric clock in motion. In answer to which, I wish to say that the pendulum bob being made of a reel of insulated copper wire, and the electricity in going through it, it forms an electro-magnet, which is attracted by the permanent bar magnets, which are placed with their similar poles to each other; but a little before the pendulum gets to the end of its stroke, the circuit is broken, and the magnetism of the bob is gone, and the pendulum falls by its own weight. After it has passed the centre of gravity, the circuit is made, and is again attracted by the magnets in the tube, and set at liberty, as before.

Can any reader inform me how the tips of bagatelle cues are put on, and what they are made of?

J. W. Moore.

POWER OF STEAM.

Sir,—Will you kindly inform me what will be the relative power steam will have upon the various forms of piston surface annexed? They will be pushed forward in the cylinder with varying degrees of force proportionate to the effective area—not superficial extent—offered to the power of the steam; but according to what mechanical law or rule can the force of steam upon a convex or concave surface, for instance, be resolved and compared with its force upon a plain flat surface?



Pressure in every case considered from below.

Taking the upward pressure on *a* to be the most powerful, and giving it 10 as a standard, in what order would you arrange them with corresponding numbers? From this I wish to gain the principle.

If steam of equal densities be placed above and below E and F, will the pressure on the sides *m*, *n*, or *m''* affect the downward force acting on *q*, *q*. J. R. M.

PRESSURE ON BOILER.

Sir,—In answer to "R. E. Mellor," I beg to present the following formula, as given by W. Fairbairn, Esq.:—

$$C = \frac{DP}{2T}$$

Where C = Thickness of plate.
D = Diameter in inches.
P = Pressure in pounds.
T = Tenacity on strength of riveted joints.

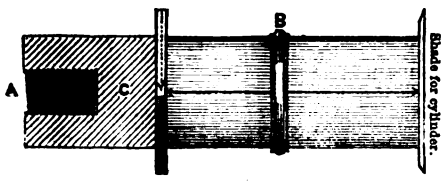
The working pressure of your boiler being 80lbs. to the square inch, the bursting pressure should be 400, then 400 × 12, and divided by 2 × 34,000, the strength of riveted joints would stand thus:—

$$\frac{12 \times 400 = 4800}{34,000 \times 2 = 68,000} = \cdot 07 \text{ inches.}$$

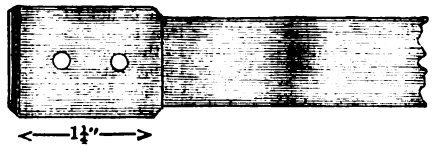
giving ·07 inches as bursting power. Hoping this will convey the information required. Aspirant.

BORING AND TURNING CYLINDERS.

Sir,—In answer to "J. H. J's." inquiry how to bore small brass cylinders; turn a brass chuck to fit the hole already bored out in the cylinder; set it on the chuck about 1-32in., then tin the chuck and the end of the cylinder, and apply heat to them till they are soldered. Then you can bore and turn the cylinder with one chucking—thus:—



(A is the screw mandril; B, the cylinder, and C, the chuck.)



The boring bit must be flat, 3-16in. thick, and diameter of holes ¾in. The shank may be of any length of steel. The bit must be packed on each side with wood, with two screws through to hold the wood while being turned the size of the bit. Turn the cylinder out to bit point of boring bit.

Glenluce.

PISTON VELOCITY.

Sir,—According to Bourne, the speed of a piston increases as the cube root of the length of the stroke. Supposing a piston, 16in. dia., 2 feet 6in. stroke, working at 20lbs. pressure per square inch, to maintain a velocity of 220 feet per minute; then, by increasing the length of stroke to 5 feet (pressure, diameter of piston, and load, remaining the same), we get by the above rule 277 feet per minute as the increased velocity, due to increased length of stroke, for $\sqrt{2 \cdot 5} = 1 \cdot 357$, and $\sqrt{5} = 1 \cdot 71$, and $1 \cdot 71 \div 1 \cdot 357 = 1 \cdot 26 \times 220$ feet $= 277$ feet.

But if "J. T. M." reduces the piston to 8in. diameter, or only ¼ the former area (instead of ½, as he erroneously supposes); then (velocity being directly as the pressure, and inversely as the load) he must either increase the pressure to four times the amount, or 80lbs. per square inch, to get the same quantity of work done, or reduce the load to one-fourth the amount, to maintain the increased velocity.

James Lott (Engine Driver).

P.S.—Bourne gives the velocities of ordinary engines at 128 times the cube root of the stroke in feet; but I have charge of an engine two feet stroke working 240 feet per minute.

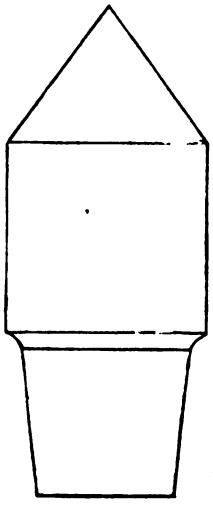
GAS PURIFIER.

Sir,—In answer to "Vesta," his gas purifiers having too much pressure, I should recommend him to first examine the dip and syphon of the inlet pipe betwixt the purifiers and gas holder, and if these show no more dip than two inches, then he may come to the conclusion that the pipes are partly made up, and require a blast of steam driving through them to remove the tar, &c.; then pump the syphon mentioned above, to make sure, and if that does not eradicate the evil, apply again through the columns of The English Mechanic. Thomas Jackson.

FALLING BODIES.

Sir,—If the attraction of gravity on two different masses is in proportion to the density or specific gravity of such masses (which I do not dispute), how comes it that a guinea and a feather, the former being, say, 500 times the specific gravity of the latter, let fall from the top of an exhausted receiver, both reach the bottom in the same time? The guinea being impelled, or attracted by, say, 500 times the force acting on the feather?—ought not its velocity to be proportionately increased? An explanation from some of your philosophical readers would greatly oblige J. L.

LATHE CENTRES.



Sir,—I think there must be some mistake in that given—70°, 80°, and 90°—for lathe centres, 45° being rather the best of the four. I think about 35° is very good, and any one in practice must know that a very long tapered centre is constantly boring into the work, and making it untrue. I beg to offer a sketch of the best working centre. This angle will bear a great weight, without destroying the centre in the work. All centres in work to be turned should be drilled up to keep the work true. It is very often thought that a long tapered centre carries the weight best in turning lathes; and so it would, if the work did not turn on it.

To harden centres: make the tapered part a very dark red heat, and cool it in clean water.

Taking the cold chill off water prevents many tools from splitting, and breaking when being hardened.

Kilmarnock.

COPPER WIRE.

Sir,—I certainly am surprised to see a note from Mr. G. Taylor upon this subject in your last issues and in reply to him; I have had the naked wire gauged by a very delicate pinion gauge, which, by calculation shows the wire to be of the diameter of about ·005 of an inch. The guage by which the number 35 is arrived at is the B.W. gauge.

As to Mr. Scrace being a friend of mine, I desire to inform "G. T." that I never yet saw Mr. Scrace in my life. He is to me as much of a friend as the tailor or bootmaker who undertakes to supply me with a good article at a reasonable price, and it was the desire to enable others to get similarly served that induced me ever to give Mr. Scrace's name.

Now let me interrogate "G. T." a little. May I enquire where he gets his data for the length and weights of copper wire. Mr. W. H. Preece (no mean authority on such matters), in his tables, gives No. 35 copper wire, diameter = ·005 inches, weight of one mile = 4012lbs. Therefore, I would like to know how G. T. finds that 1lb. of No. 35 only measures 1,500 yards? Perhaps G. T. would like to know how I found about one mile in the pound. It was this:—

I weighed one ounce exactly, and on stretching it out, and measuring, I found about 108 yards in an ounce. I may mention that the Liverpool agent of Messrs. Silver and Co. quoted me No. 35 silk-covered wire at the same price, —12s. 6d. per lb.

Now, if G. T. wishes to split hairs with me, let him say so, and I shall then be compelled again to trespass upon the patience of the Editor, if he will permit it; but I cannot see the necessity of haggling about a point which G. T. might have decided for himself by simple experiment, or by consulting the tables of any recognised authority upon electrical matters. T. F. Williams.

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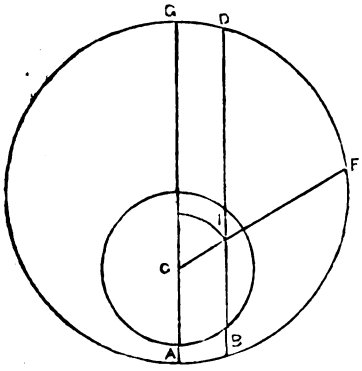
LAP AND LEAD.

Sir,—In answer to "Eccentric," the following may prove useful:—Let him draw a centre line A, C, across the sheave, through both centres; set off B, D, parallel and equal to the lap + lead of the slide valve (called the lever advance) from centre G, with radius equal to the throw of the valve; describe a radius cutting D, B, in I; draw a straight line from centre G, through T to the circumference F; set G, I, F, at right angles to the crank. The line G, I, F—the angular advance of sheave.



The following is a rule to find the lap and lead of slide valve:—

W = width of one steam port in inches; L = lap in inches; l = lead in inches; S = stroke in inches; T = travel of slide; X, the distance travelled by the piston before the steam is cut off.

$$X = S\left[1-\left(\frac{2L+l}{T}\right)^2\right]$$

$$L = \left(\frac{\sqrt{S-X}}{\frac{1}{2}T}\right) - \frac{l}{2}$$

$$T = {}_2L + {}_2W.$$

Newcastle, Oct., 1865. JAS. MORRISON.

HARDENING DRILLS.

In reply to "A Watchmaker," (No. 26), I beg to inform him of the method I adopt in hardening small drills for tempered steel. I take a lighted candle and hold the point of the drill in the flame until it is a dull red, and then dip it into the melted tallow. Care must be taken not to bend the drill in dipping. I find this method very successful for cutting anything hard, using turpentine to the drill instead of oil. Perhaps "A Watchmaker" is not aware that as much depends upon the form of the drill as the tempering of it.

When the article is very hard, the hole should be begun with the drill, formed as in No. 1; then after it is entered the face as in No 2, and then as in No. 3; when with a good chisel face it will cut its way beautifully.

JOHN MCKAY.

ECCENTRIC CHUCK.

Sir,—"W. G. P."—To cut the screw in the dividing wheel of an eccentric chuck:—

Divide the same with the number of teeth required; then take a small cold chisel ground to the form of the V thread of your tangent screw; then, with two or three blows of a light hammer, drive the chisel into each mark, then mill it up with a screw hob in the lathe.

WM. MUM.

MARINE GLUE.

Sir,—In reply to "J. Bunney," I send the following:—In half gallon of mineral naphtha, dissolve two ounces India-rubber. When the rubber is dissolved add more than twice the quantity of shellac than naphtha; then put the whole in an iron vessel, apply heat, and stir till mixed. Then pour out on slab to cool, and cut in pieces. This glue is to be melted like common glue, and applied with a brush. When dry, it is perfectly insoluble, besides being elastic.

F. H. COLLINS.

IF the light emitted from a heated platinum wire be examined by means of a prism, it will be found that as the heat increases in intensity, so the various colours of the spectrum are emitted until it reaches a white heat, when all the colours will be found to be correctly and simultaneously displayed.

THE mineral statistics for last year show that the quantity of coal produced from 3,268 collieries amounted to 92,787,873 tons, which is valued at the pit's mouth at £23,176,968. Of this the foreign exports were 8,500,000 tons, an increase of 500,000 tons in comparison with the returns of 1863.

THE Liverpool Corporation, under the powers of a new local act, are about to provide a series of lectures on art and science, to which the public will be admitted gratis.

WELDLESS TYRES, CIRCULAR ROLLING, AND RAILWAY WHEELS.*

In this paper an account is given of the mode of making tyre hoops for railway wheels prior to the invention of weldless tyres, and that such mode consisted in bending a straight tyre bar into a hooped form, the ends of the bar having been previously prepared if the weld to be made were any other than a "butt" weld, and then in uniting the ends together by welding in one of the methods known as the "scarf" weld, or the "double V," or the "bird's mouth," or the "single V" weld, that each one of these welds required the operation to be performed when the tyre was removed from the fire, and that they were all of them objectionable. The writer believed the butt to be the best weld of all, but that nevertheless even this best of welds was from the risk of unsoundness a source of danger. He then briefly describes the process of "blocking" the welded tyres for the purpose of stretching them to uniform sizes, and also with the view of ascertaining the soundness of the weld, and then alludes to the operation of shrinking the tyre on to the wheel centre, either preceded or not by a boring process, and then speaks of the fastening on of the tyre, and of the completion of the wheel by the turning of the exterior of that tyre.

A description follows of the mode in which in the year 1844 Mr. Bramwell proposed to make tyres without a joint weld, now known as "weldless tyres." This mode consisted in winding a long bar of iron into a helical coil of very nearly the size and shape of the required finished tyre hoop, and then in placing this coil in a circular furnace having an opening or "gash" of the form of a sector of a circle when seen on plan, such sector subtending about 60 deg. or 90 deg., and having placed within it a quick-going mechanical hammer, provided with tools of nearly the shape of the finished tyre, and adapted to operate on that portion of the hoop that lay out of the furnace and in the sector. By this means the writer proposed to weld the whole circumference of the coil by bringing welding hot portions successively out of the interior of the furnace into the sector-shaped "gash." He proposed to finish off the ring forging thus made by means of the circular or rolling machine which had been invented by Mr. Bodmer in the year 1839, by which the continuous rolling of a ring could be effected. Mr. Bodmer, he said, did not propose to make a weldless ring, but, on the contrary, intended to make that ring by welding together the ends of the bar, and that the object of his invention was to finish tyres by rolling instead of by turning them in a lathe. The writer then states that, although between the years 1844 and 1845 some few persons brought forward propositions for making weldless tyres, nothing really was done, as far as the writer knows, in the way of manufacturing; that in the latter year the writer proposed the subject to Mr. William Owen, of Rotherham, who commenced to make weldless tyres in the year 1860; that prior to this, viz., about the year 1856, the manufacture of such tyres was begun by Jackson, Petin, and Gaudet, in France; that Mr. Owen, and the limited company who have succeeded him, have carried out the making of weldless tyres to a very large extent, using machinery nearly the whole of which has been designed by the writer, and that they are now increasing their works. The writer then gives a description of the process then pursued by the Owen's Company, which consists in making a helical coil of about half the diameter, and three times the width of the intended tyre, the heating of this coil in a furnace, and then putting it into a mould on the anvil of a steam hammer, and by the action of the top tool upon it welding it into a block of about half the diameter, and twice the thickness of the finished tyre; the removal of this block to a circular rolling machine on Bodmer's principle, but combined with hydraulic power of such character as to be capable of rolling out the tyre to its proper decreased thickness and increased diameter.

The writer then goes on to show that not only is the manufacture of weldless hoops completed by circular rolling one that insures soundness and safety, but that also in consequence of dispensing with the "crop ends," and of passing backwards and forwards of the bar being rolled, both of which accompany, and are drawbacks to ordinary rolling; such manufacture of weldless hoops is really an economical mode, and might be advantageously employed for the manufacture of all heavy straight bars, rails, and plates. The writer then alludes to the making of steel tyres by the various processes used by Krupp, Bessemer, Vickers, and Owen, and points out how beneficial the use of weldless rings would be for boiler work, as they would dispense with the longitudinal seams which are the source of weakness in boilers. He next describes the improvement in manufacturing solid wrough-iron wheel centres invented by M. Arbel, of France, and practised by the Owen's Company (Limited), which consists in putting together the various parts forming the rim, spokes, and boss, and heating the same in a furnace from which they are removed into a die, where, by the action of a powerful hammer, having, when its moving parts are fitted so as to make the centres of engine wheels, a weight of more than 25 tons, and a maximum drop of 6 feet. A common kind of wheel centre in very general use, wherein wrought spokes are combined with a cast-iron boss, is next described, and the objection to this mode pointed out; he then states the improvement of Mr. Lahousse, of Belgium, as practised by the Owen's Company, by which the advantage of a wrought boss can be obtained at a rate as economical as that of a cast-iron boss, and shows that is done by enveloping cold or moderately heated wrought-iron spokes in the highly plastic halves of a welding hot wrought boss, by which the spokes are firmly embraced and held fast.

* Read by E. J. Bramwell, C.E., before the British Institution.

THE SOUTH STAFFORDSHIRE AND WORCESTERSHIRE COAL-FIELDS.

The first public lecture in connection with the recent meeting of the British Association was delivered by Mr. Jukes, on the subject of the probable extent of the coal measures beneath the red rocks of the Midland Counties. Mr. Jukes, after giving a history of the South Staffordshire and Worcestershire coal-fields, and showing from the rapid consumption of fuel that new and more difficult ground would have to be opened, proceeded to notice some of the difficulties in the way of satisfactorily reaching the untouched strata. Should additional coal be found in Staffordshire and its vicinity, it would have to be sought beneath the red sandstone, which careful surveys proved to exist to a considerable extent, and the practical problem for solution was under which part of the red sandstone did coal measures, with workable coals, exist. How thick was that new, red covering in those parts? and did the permian rocks also occur between the sandstone and the coal? were most important questions, and difficult to answer. The problem was one which might fairly be put before her Majesty's geological survey, under Sir R. I. Murchison, with the expectation that some approximation to its solution would be authoritatively stated. As regarded the thickness of the red sandstone, it was probable that such of the two sub-groups into which it was divisible attained a maximum thickness of 1,000 or 1,500 feet, though it was doubtful whether they ever both had that maximum at any one locality. In sinking for coal, then, anywhere in the red marl, it would be only prudent to allow 600 yards, or 1,800 feet, for the thickness of the sandstone, and three or four hundred yards additional for possible permian rock. A possible thickness, then, of 1,000 yards, would have to be pierced before arriving at that point at which the occurrence of coal measures would be possible. If they did occur, a still further depth of 300, or perhaps 400 yards, might have to be reached before a good workable bed of coal could be found. At the Duke of Newcastle's pits, near Worksop, after piercing the permians they sank 1,280 feet before reaching a good workable coal. Anyone intending to try for coal beneath the red rock must be prepared to sink boldly 1,000 yards before he had a chance of meeting with the coal measure. It was quite possible that the red rock covering (taking trias and permian together) might have that thickness at any spot selected. There was then a chance, and only a chance, of the speculator finding himself in the coal measures with good beds of workable coal still beneath him. But there was only a chance of finding coal measures destitute of valuable beds, or of not finding any coal measures at all, but coming down into millstone, grit, or carboniferous limestone, or some lower palleoeoic rock, the coal measures having been removed by denudation before the red rocks were deposited. In such a hazardous speculation they could not expect private individuals to engage. The work would either have to be undertaken by a combination of proprietors, or it would have to be undertaken at the expense of the nation. Mr. Jukes declared his opinion to be, that the national importance of determining the extent and position of the coal fields beneath the red rocks of the Midland counties was so vast that the exploration must be made at the national expense, with of course every fair provision for its repayment by those most immediately benefited by it.

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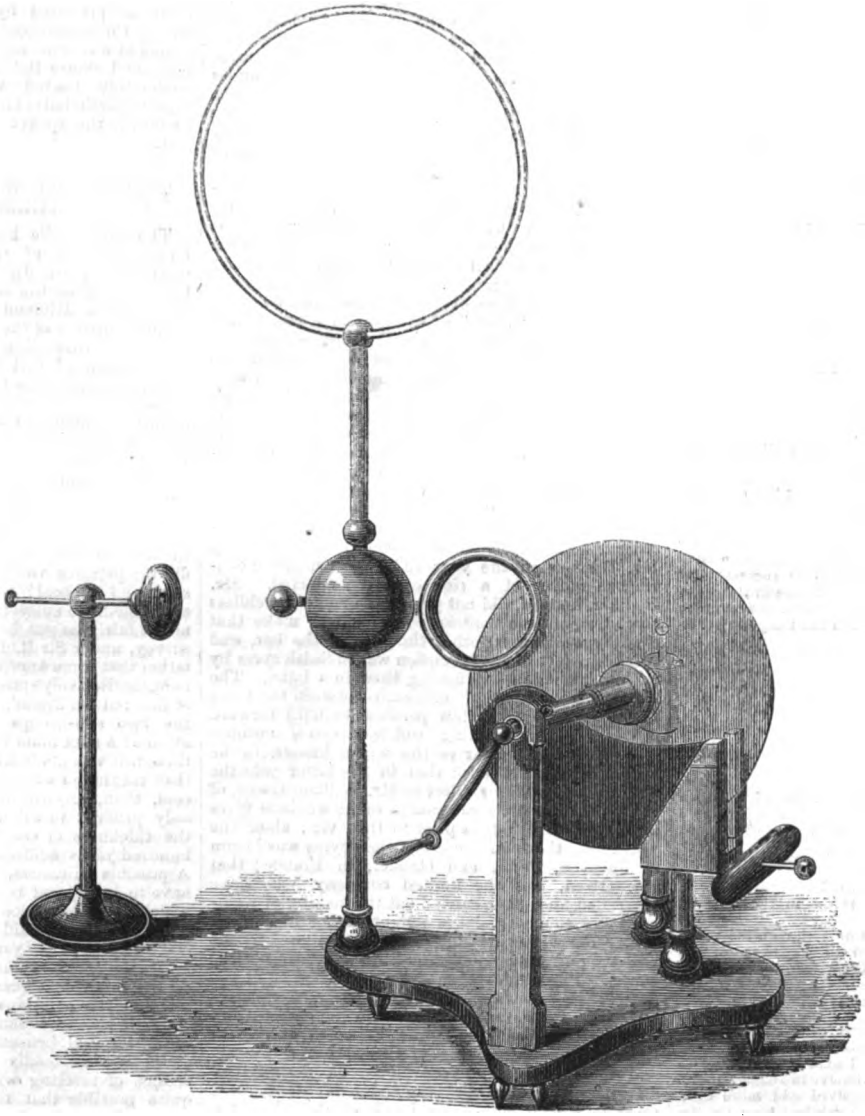
WINTER'S ELECTRICAL MACHINE.

In number 27, we expressed our determination to close our columns for the present to the subject of electricity, but the flood of letters which have come to hand has induced us to keep open for a week or two longer. To satisfy a crowd of correspondents, who seem altogether to have forgotten that what they have asked for has been published at length, and to enlighten several on a few new points of interest, we give an illustration and description of the machine invented by Herr Carl Winter, of Vienna. It was first introduced into this country by Dr. R. M. Ferguson, of Edinburgh, in 1857. The Doctor had seen one in Vienna and different cities in Germany before he had one made. The largest he saw was in the Vienna Polytechnic School; it had a plate 5 feet in diameter which gave off sparks 4 feet long. However, a very good size is a 2 feet plate. At first the pillars were made of glass, but Mr. Varley, of London, made his large sized one of vulcanite, and found the insulation improved. The machine is essentially a plate friction machine, and with a 2 feet plate will give 11 inch sparks. If made in the ordinary way such a machine would be considered very successful if it gave, in the most favourable circumstances, a spark of 5 or at most 6 inches. All who have had to do with electrical machines know how extremely difficult it is, even with the requisite means of drying, to keep them in a state favourable to ready action for any length of time; though Winter's machine he left in a room for months where, during that time, there has been no fire, yet by the first turn of the plate it will give sparks 10 inches long. The cause of this efficiency may principally be attributed to the rubbers he employs, the perfection of insulation, and to the contrivance for lengthening the spark. The accompanying illustration represents one of these instruments. It will be seen that the plate is fixed into an axle which revolves in two upright supports. One of these in which the shorter wooden end of the axle revolves is made of glass, and the other, in which the longer glass end of the axle revolves, is of wood. Thus the electricity formed upon the plate cannot reach the ground on either side, for on the one side the insulating glass pillar, and on the other the insulating glass axle, prevents it. The friction, as usual, is caused by pressing on the plate of glass a flat surface of leather covered with an amalgam of mercury, zinc, and tin, which is put on with the aid of a little grease. The frame standing on the low glass support to the right of the figure is the wooden rubber frame, into the notches of which fit two flat pieces of wood covered in front or on the side next the plate with leather, and a very little stuffing, and provided on the other side with springs, which, acting against the frame, keep the front surface uniformly pressing against the plate. There is only one pair of rubbers, not two, as in ordinary machines, and this enables them to be placed at a greater distance from the prime conductor of the machine.

The brass ball on the tall glass support to the left is the prime conductor. For more perfect insulation this ball is fitted on to the support by means of a trumpet-shaped opening made in it, thereby preventing the dispersion of electricity that would arise from the sharp edge of a hole exactly large enough for the rod. There are three other openings in this ball, one on each side, and one at the top. The two small rings which are seen projecting upon the plate fit into one of these by means of a T-shaped piece of brass. They are made of wood, and have a groove cut in them on the side turned towards the plate, into which a row of fine pin points is fixed for collecting the electricity formed upon it. These points are connected with the prime conductor by means of a strip of tinfoil which lines the bottom of the groove. Two wings of oil silk, attached to the rubbers, stretch between them and these rings, so as to prevent the electricity from dispersing itself before reaching them. The opening in the top of the ball is made to receive the stalk of the wooden ring, which is seen surmounting it, and which forms the most peculiar feature of the instrument. The function performed by this remarkable appendage is to lengthen the sparks given by the machine.



WINTER'S ELECTRICAL MACHINE.

It is a wooden ring, and may be from 32 to 36in. diameter, with a thin iron wire inside to form a core, which also passes down the wooden stalk, and is in metallic connection with the brass ball or prime conductor. This ring can be removed at pleasure; when removed, it is an ordinary plate machine of the best construction. The sparks then are straight and thick, and not more than two or three inches long; whenever the ring is put on they are at once lengthened to 10 or 12 inches. It would seem that the electricity accumulates with great intensity on the thin wire which forms the core above noted, the wooden covering preventing dispersion. Dr. Ferguson tried different rings; he had one of polished iron wire, and got 6in. sparks; covered with gutta percha he obtained 12in. sparks; puncturing the covering the length of spark fell to 6in. Other kinds of rings were tried, but none proved so good as that described. This is probably owing to its semi-conducting power, or superior elasticity, or in that it cannot be permanently punctured like gutta percha. To the left of the figure is the spark drawer, for receiving the sparks from the machine. The length of the spark is the test of the construction of a machine, and it would appear that in this respect Winter's holds first rank. Indeed, it is something quite novel in the history of electrical apparatus; concerning which, Mr. W. Hart, of No. 7, North College-street, Edinburgh, has expressed his willingness to answer correspondents by letter.

TURNED, &c., WORKS IN IVORY.

According to the nature of the work done in this useful and ornamental substance, so is the mode of polishing; and the remarks on the subject applicable to the tusks of the elephant and other animals apply also to vegetable ivory and bone, when applied to similar uses.

Plain surfaced turned works may be left so smooth from the tool as to require no polishing, and this point is always aimed at by a good workman, who will provide himself with the sharpest of tools. In polishing very fine glass or emery paper is first used, and the work is rendered still smoother by rubbing the faces of two pieces together; next, whiting and water, as thick as cream, is applied on wash leather, linen, or cotton rag, which should, moreover, be so thin that the fingers may readily feel and avoid the edges of the work to be left keen. 3rdly. When the work hangs less to the rag than at first, it is washed with clean water on a rag, and finally, is rubbed with a clean rag with a clean dry cloth until all the moisture is absorbed, and a very minute quantity of oil or tallow is put on with a rag to give a gloss. Scarce any oil remains behind, and the apprehension that the ivory will absorb it and be thus disposed to turn yellow may be discarded; the quantity of oil used is very small, and its main object is so to lubricate the surface that the rag may not hang and so wear rings or groove marks. Putty powder is frequently used for polishing ivory work, but it is not more suited for the work than is whiting, and is more expensive.

The turned works consisting of many parts should be polished separately, as they are then more comeatable, and the whiting and water have not the chance of penetrating and clogging the joinings, and so preventing their easy separation. The best workmen frequently polish screw threads, to ensure easy movement, and to make them live longer without wearing loose. The practice is to be commended. Those turned works ornamented with the eccentric chuck, revolving cutters, &c., also require to be cutwith very sharp tools, to save polishing.

Irregular surfaces are generally polished with a moderately hard nail brush, supplied with whiting and water, lightly applied in all directions, so as to penetrate every interstice; after a period the work is brushed with plain water and a clean brush to remove every trace of whiting. The ivory is dried by wiping and dabbing with a clean rag, and is afterwards allowed to dry in the air, or at a good distance from the fire. When dry, a gloss is given with a clean brush, on which a minute drop of oil is first applied.

"It is better to do too little polishing at first," says Mr. Holtzappffel, "so as to need a repetition of the process, rather than, by injudicious activity,

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to round and obliterate all the delicate points and edges of the works, upon the preservation of which their beauty mainly depends."

Superior flat work is accurately filed and scraped, then cleaned with fine glass paper, folded round a square stick; afterwards with whiting placed on a flat square stick used as a file. This naked polisher produces a more exact and better defined edge than when covered with cloth. Common filed and carved works are finished, first, with Trent sand and water on a flannel or brush; 2nd, scraped Flanders brick similarly applied; and 3rd, a wet rag with powdered chalk, which soon rules down smooth. Razors and knife handles are finished sometimes by shaving or scraping, or by buffing them on the wheel; some prefer the following methods:—(1.) common razor handles are first sawn out and filed, then scraped with the shaving blade: two razor handles or scales are then held at the one end in a pair of clamps in the vice, and rubbed lengthways, first with chalk and water on felt or cloth, and then with whiting and water for the finish. (2.) In the case of best razor handles, two scales are slightly rivetted together and buffed—first, on a buff wheel fed with Trent sand; next, buffed with rottenstone; and lastly, they are polished with the naked hand and rottenstone. Other workers omit the rottenstone, which requires oil, using chalk and whiting, which require only water. (3.) Umbrella and parasol handles, and many similar pieces are polished, first, with sand, and then with whiting, on cloth wheels (several circles of cloth or felt clamped between two discs of wood); the cloth projecting about an inch around the margin to make a soft elastic edge.

With these simple means is produced the beautiful polish on ivory surfaces.

CHEMICAL AND MECHANICAL OIL-TESTS.

(*Concluded from page 27.*)

Fish oils may also be detected by passing chlorine gas through suspected oil, whereupon a black coloration ensues. Mr. Tomlinson determines the quality of some oils by letting a drop fall from a chemically clean glass rod held just above the surface of a glass vessel containing perfectly clean and undisturbed water. The peculiar form and general appearance of the drop indicates very distinctly the nature and quality of the oil. This process enables one not only to detect common adulterations, such as of olive oil, for instance, with poppy or sesame oil, but even to distinguish the respective oleines of beef tallow and mutton tallow. Engravings of the appearance of drops of various oils, and other particulars, are to be found in the paper read by Mr. Tomlinson before the Society of Arts, and published in their Journal, Vol. XII., 1863-64, page 246.

There are several varieties of mechanical tests for lubricants. M'Naught's oil-test has had the longest reputation. This well-known contrivance consists essentially of two revolving discs, between which the lubricant is introduced. The centre of the upper disc rests upon a pivot in the centre of the lower one, the latter being driven by a cord-pulley on its spindle. The film of the oil to be tested is interposed, and, as the upper disc is carried round by reason of the tenacity of the oil on the lower revolving one, it presses, by means of a pin, upon the end of a lever in connection with a steelyard lever carrying an adjustable weight. The tenacity of the oil, or, in other words, the want of lubricating qualities, is thus indicated and measured by the weight which the pressure of the pin of the upper disc will raise on the steelyard. The oil-test of Desbordes, of Paris, is identically the same. Hirn's oil-test is also similar in principle to M'Naught's—a hollow revolving drum taking the place of the lower disc, whilst the upper one is represented by a bearing resting freely on the drum, and carrying a long steelyard, to the one end of which a scale-pan is hung, whilst to the other a weight is attached as counterbalance. The oil is introduced between the bearing and the drum by allowing the lower part of the latter to revolve in a vessel containing the lubricant, and its tenacity is measured by the weight that is required to counteract the raising of the scale-end of the steelyard, caused by the friction of the drum upon the bearing whilst revolving in the opposite direction. The heat created by the friction is estimated by one thermometer, which measures the temperature of water injected into the hollow drum, and also by another thermometer placed in a suitable part of the bearing. The speed of working is likewise determined by a little contrivance, and the combined results indicate, with considerable accuracy, the nature and value of the lubricant. The chief objection against it is the considerable oscillation of the steelyard. Waltjeii's oil-test is constructed on the same principle as Hirn's, but is so complicated as to require three or four woodcuts to describe it properly. It is used a good deal in Germany.

Sinclair's oil-test is simple and cheap. A short horizontal spindle has end journals carefully turned upon it, to run in brass bearings fixed in the tops of two brackets or pedestals. The central portion of this spindle is increased in thickness, and is turned with a spiral groove to receive a length of 3-16ths of ¼ inch gut or cord. One end of this cord is looped on a pin in the spindle, whilst to the opposite end a weight is hung. The shaft carries at one end a fly-wheel to give it impetus when in motion. The oil to be tried is laid on the two journals, the weight is wound up, and then allowed to descend freely, the cord of course falling off the pin when run off. The quality of the oil is determined by the length of time the shaft revolves, which is easily ascertained by a seconds watch. Thomas's oil-test is very much the same, a disc taking the place of the barrel of the spindle and giving sufficient impetus to enable the fly-wheel to be dispensed with.

Nasmyth's oil-test determines the quality of a lubricant by finding how long the oil takes to flow down an inclined plane. A plate of iron, six feet long, provided with a number of longitudinal grooves of equal size, is placed so that one end is an inch higher than the other. Equal samples of each of the oils to be compared are then poured simultaneously into the upper end of these grooves, and are then left to flow towards the lower end. Some oils which for the first two or three days appear to be most fluid and make the furthest progress begin to thicken, and are then passed by the better oils, some of which continue the race eight or ten days. In Mr. Nasmyth's trials, for instance, linseed oil flowed most freely for one day, but stopped within 18 inches of the top, whereas sperm oil flowed nine days to within two inches of the bottom. C.O.P.

PHOTOGRAPHY.

Transferring Photographs to Metal for Printing.—Same months since we called attention to some very promising experiments in this direction, conducted by Mr. Woodbury, of Manchester. These have resulted in a process recently patented, which is likely to assume a very important position in the arts. Mr. Fox Talbot has the merit of first pointing out the facts upon which it is based. This gentleman, to whom photographers too often forget how much they owe, discovered in connection with one of his photo-engraving processes that gelatine when dissolved in hot water, if mixed with bichromate of potash or ammonia, dried and exposed to the action of light, would become insoluble. A result due to the decomposition of the alkaline bichromate and the liberation of chromic acid. It will at once, therefore, be seen that a coat of the bichromated gelatine on a glass or metal plate placed under a negative and exposed to light, would, when subjected to the action of hot water, be dissolved away in some parts, and in other parts unaffected, thus producing a photographic positive *in relief*. Acting on these facts, Mr. Woodbury takes the image in relief so produced, and either by mechanical pressure with some soft metal, such as type metal, or by the usual process of electrotyping, produces an *intaglio* impression therefrom. A properly prepared ink, formed with gelatine and some black or other coloured pigment, is then passed over the plate, with which the impression is filled up even to the surface. Of course the gradations of *relief* in the bichromatic gelatine print, form gradations of *depth* in the metal intaglio, in which again the ink, being transparent, forms gradations of blackness proportioned to its varying thicknesses.

A New Developer.—A very valuable suggestion emanating from Mr. Carey Lea, has brought forward a new and superior developer, the best formula for which, perhaps, is one given by a clerical correspondent writing to the *British Journal of Photography*, who says:—"Dissolve ten grains of Nelson's gelatine in an ounce of Beaufoy's acetic acid (that at 10d. per lb.). Make your new developer of the strength you are accustomed to use—of course without any acid; and to each ounce of it add one drachm of the gelatinised acetic acid. You will be pleased with the result, and with its cleanliness and ease of preparation." This developer will be found to bring out the images with unusual vigour and brilliancy, and may be retained on the plate for a long time without "fogging." Where from unavoidable difficulties under-exposure has arisen, this quality alone will render it invaluable.

PROGRESS OF INVENTION.

Sterrometal.—This important alloy possesses some valuable properties which make it well deserving of attention. It may, in many cases, be substituted for bronze, iron, or steel, with great advantage, and is likely to prove valuable to the makers of various kinds of instruments and machinery. It is formed by fusing together from 55 to 57 per cent. copper, from 40 to 42 per cent. zinc, 1·8 per cent. iron, and from 0·15 to 0·8 per cent. tin. The colour of this compound is very similar to that of gold. The cast metal is rendered malleable and ductile by hammering or pressure, at a red heat—a higher heat would produce brittleness, and a lower would injure the texture. The tenacity of the cast metal is equal to the support of 42·29 kilogrammes the square millimetre; of the malleable, to the support of 53·99 kilos.; and of the ductile, to the support of 59·72 kilos. It takes a fine polish.

Black Phosphorus.—Hitherto we have been accustomed to consider white as the colour of perfectly pure phosphorus, or red when the phosphorus is in the amorphous state. There is now, however, good reasons to believe that its normal colour is black. Long ago, Thenard obtained black phosphorus; but the process he used was more or less uncertain, and it was never repeated with success by other chemists. M. Blondlot has, however, discovered an infallible process for obtaining black phosphorus. He purifies phosphorus of the ordinary kind by repeated distillations in a sand-bath and in a current of hydrogen; the yellow or impure portion, which is volatile—and therefore not separable by distillation—being changed into red amorphous phosphorus, which is fixed, by exposure for several days to insolation, previous to each repetition of the process of distillation, and the product being received into distilled water, kept at 90° Cent. When the phosphorus is becoming thoroughly pure, if slowly cooled, it will on falling to 42° be a white mass, which, when, 8° or 10° are reached, suddenly changes to black. Black phosphorus becomes colourless again by fusion, but recovers its blackness if slowly—and sometimes if suddenly—cooled. It is like common phosphorus, except that it is more stable, softer, and more flexible. It becomes coated with white, in water; and with red, in the atmosphere: but a single distillation renders it, in each case, again black. Very old phosphorus—it is supposed by some kind of spontaneous purification, depending on a change in its molecular condition—is very often changed to black throughout its whole mass, except the outside, which is red.

A Simple Method of producing Ice on a Large Scale.—Refrigeration is now used extensively for industrial and other purposes. Solid matters dissolved in fluids are thoroughly separated from them by freezing; and the principle has been applied with great success to the obtaining of the sugar from syrups, &c. A simple and economic method of producing a freezing temperature is therefore of considerable importance. A new method of effecting this has recently been tried in Paris, with very successful results. It depends on the circulation of ether; but unlike the other processes in which this is used, it requires no pump. The amylic ether which is employed is obtained and purified in the usual way. Its vapour is transmitted at a pressure of from five to seven atmospheres into a vessel, in which it becomes liquified. When a cock is opened for the purpose, it passes from this vessel into spiral ducts which surround the reservoir filled with the water, &c., which is to be frozen, and immersed in a solution of salt, which is not frozen even by a very low temperature. After having been vaporized in the spirals, the ether vapour passes into three large cylinders containing sulphuric acid, by which it is absorbed. A portion of the ether is always ready to be driven from the saturated solution containing it, by means of the heat which is supplied by superheated steam, into the vessel in which it is again liquified, preparatory to its being again used for the production of cold by evaporation. A machine calculated to form in this way 200 kilogrammes of ice in an hour has been constructed for the separation of the salts contained in sea-water.

A Good Marking Ink.—An excellent marking ink may be made by dissolving fused nitrate of silver in water, saturating the solution with ammonia, and adding pulverised gum-arabic, to prevent the writing from spreading on the linen. Before using this mixture, the place which is to be written upon is to be moistened with a solution of pyrogallic acid in alcohol and water, and then dried. The writing must be made with a quill pen; it will be of a deep black, and not removable by the metho used ordinarily for washing clothes.

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EMERY AND ITS PREPARATION.

(*Continued from page* 32.)

It will not be out of place to supplement the matter appearing in our last with a description of the invention of Mr. Henry Barclay, which consists in combining powdered emery into discs and laps of different kinds, suited for polishing, grinding, and cutting glass, enamel, metals, &c. The process of manufacture is as follows :—

Coarse emery powder is mixed with half its weight of Stourbridge loam, pulverised to a thick paste, with a little water. This is pressed into an iron mould by means of the screw press, and, after being thoroughly dried, is baked or burned in a crucible, or, otherwise, in a furnace, at a temperature considerably above red, but below full white heat. The clay serves as a bond to unite the particles in a solid "artificial emery stone," which, while it cuts well, does not readily show wear. Superfine grinding emery is formed into wheels, as is the previous kind; but the loam is only one fourth instead of one half of the proportion. The stones so made cut more smoothly, but not so quickly as the first.

When flour emery is made into artificial stones, it alone, moistened, is forced into the mould and fired. These fine wheels render the articles on which they operate exceedingly smooth: but they do not produce a high polish.

Slate, Yorkshire gritstone, crocus, &c., may be used in uniting the particles of emery as well as the loam; and thus the hardness and cut of the emery stone may be varied.

Emery-stone grinders are made with central holes, so as to admit of being attached on appropriate chucks or spindles, to the lathe; and the substance is so porous as to absorb much water, which is gradually thrown to the surface, so as to keep the edge conveniently moist—or, with excessive velocity, the water is "trundled" off as from a mop. Mr. Barclay made discs from ¼ inch to 8 or 10 inches diameter; but the difficulty increases with the size, the larger ones being liable to warp and crack during firing.

When the emery stone laps are required to have plane surfaces, angular or convex edges, &c., not readily moulded, the composition is fired at a low heat, turned in a lathe to the form required; and, firing at a nearly white heat, finishes the job.

Coarse emery stone has been tried in glass-cutting, and is stated to be able to take the place of the iron disc fed with sand used in roughing, of the Lancashire fine grit stone used in smoothing; and when of a proper consistence, cuts as quickly as the former, smoothly as the latter, and has the advantage, also, of maintaining its form. Fragments of these discs, spoiled in firing, have been successfully used in scrubbing off the rough sand of door plates, mouldings, &c., cast in brass.

Necessity compelled Mr. Barclay to take up the subject of artificial emery stone, as in his business, of making artificial teeth and gums, of a kind of hard porcelain, he found the small Yorkshire-stone grindstones wear out very rapidly, even when assisted by coarse sand and water. Some of the small artificial stones, made as above noted, have been in constant use for three or four years.

STEAM BOILER EXPLOSIONS.

At a recent meeting of the Executive Committee for Prevention of Steam Boiler Explosions, the following appeared in the Chief Engineer's report:—

"No. 29 explosion, which is the only one reported during the past two months, occurred at a marine engine and iron shipbuilder's work, at about twenty minutes before six on the morning of Monday, July 31st. Two persons were killed, and a third injured by the explosion. The boiler was not under the charge of this Association.

"I had no opportunity of making a personal investigation of this explosion, but have been favoured with a report thereon, accompanied with sketches from an engineer who examined the boiler officially at the request of the coroner, and gave evidence thereon at the inquest. From this it appears that the boiler was of plain Cornish construction, having a single flue, and being internally fired. Its length was 17 feet, its diameter in the shell 6 feet, and in the furnace tube 2 feet 10½ inches, while the thickness of the plates was 7-16 of an inch, and the load on the safety valve about 55lb.

"The boiler failed from collapse of the furnace crown, which gave way at about 6 feet from the front end or furnace mouth, rending transversely in two places close to the seams of rivets, and also rending longitudinally for half the length of the furnace tube at a seam of rivets running along the crown towards the back end of the boiler. The boiler was not removed from its seating; but from the rush of steam and water that ensued upon the collapse, the three men already referred to as injured were scalded, two of whom died several days after.

"The collapse was attributed at the inquest to overheating of the furnace crown in consequence of shortness of water, combined with an injudicious introduction of the feed water. This was admitted near to the hottest part of the fire, which was just where the collapse assumed the greatest amount of depression, and where it appears to have commenced.

"Although it is difficult to speak positively, without having made a personal examination, yet there appears ground at least to question the correctness of the above conclusion. The official investigation was not made until a fortnight after the explosion had occurred, since the poor men who died from scalding lingered for some days, and there were then no positive indications of the plates having been red hot. The furnace tube was not strengthened either with flanged seams or with T or angle iron hoops, and it is reported that the crown had been damaged through shortness of water some few months previously when two new plates were put in, and also that the furnace tube was out of shape when the explosion occurred, and had been so for some time: while to this it may be added, that it was at that part of the tube which had been repaired at which the collapse assumed the greatest amount of depression and appears to have commenced. It is thought to be quite possible, therefore, that the distorted shape of the tube, as well as its previous injury and repair, may have been the cause of the explosion rather than shortness of water. But without determining whether the explosion resulted from shortness of water, or from weakness of the furnace tube, it may be pointed out that both of these dangers might have been guarded against. Low water safety valves, which relieve the pressure of the steam on the water's falling below its proper level, are a great safeguard against explosions through overheating of furnace crowns. Many of them are attached to boilers under inspection, and work well. Also the furnace flue, even though somewhat out of shape, would not have collapsed from simple pressure had it been strengthened with encircling hoops so that the explosion might have been prevented had the boiler been better made and more liberally fitted. There should also have been a duplicate glass water guage.

"It should not be lost sight of that this explosion occurred at a first-class engineering firm, since engineering firms—though by no means those who are first-class only—are too apt to consider themselves above the assistance of an independent system of periodical boiler inspection. The facts, however, are against them. The present explosion is a case in point. The boiler was made on the very works on which it exploded, and two men were killed by it. It is found as a rule that the old proverb that "the cobbler's wife and the blacksmith's horse go worst shod"—is generally applicable to the boilers of engineering firms, which is in some respects due perhaps to over-confidence. Some, however, take a different view, and only a short time since a well-known engineering firm, whose boilers are under our charge, wrote in acknowledgment of our visit of inspection, to state that, careful as they were with their own firemen, and in the management of their boilers, they still found that they derived assistance from our examinations, and felt pleasure in testifying to the value of an independent system of periodical boiler inspection even to engineers."

Salt water freezes at 28·3 deg.

Only 45 of 100 rays reach the eye after two reflections.

The flame of oil lamps contains rays not in the solar light.

In freezing water the crystals join at an angle of 60 deg.

To facilitate the tedious operation of shelling beans and peas, the *Scientific American* tells us that a Mr. Price has invented a machine. The details are simple enough, being merely a pair of rollers covered with india-rubber, similar to those used in wringing machines, and mounted in a wooden frame, in the same general way. These rollers are connected by gearing with a shaft and crank, so that when the same is turned the rollers will revolve also. In the bottom of the compartment, in which the rollers work, there are holes. These holes let the peas and beans fall into the drawer below. By turning the rollers, the pods are drawn in, and the compression causes them to burst open and deliver the peas on the other side in good order.

SCIENCE GOSSIP.

Professor Goeppert has published a book "On the Organic Nature of the Diamond." The fact that diamonds when exposed to the intense heat of the voltaic arc are turned black—converted indeed into coke—is seized upon to prove that this precious gem cannot have been produced by igneous action. Diamonds are stated by Goeppert to have often on their surface impressions of grains of sand, and sometimes of crystals showing, it is contended, that they must have been in a soft state. It is found that sometimes they enclose other crystals, germs of fungi, and occasionally fragments of vegetation of a higher order. All the facts known, according to Professor Goeppert, appear to prove that the diamond is the result of vegetable change, representing, in fact, the ultimate condition of a series of decompositions.

Archdeacon Pratt, of Calcutta, has republished his mathematical treatises, which we have noticed from time to time, the most important being that on the figure of the earth. Taking the law of universal gravitation as the basis, he calculated the resultant force exerted on a point by an assemblage of particles endowed with this attracting power, and held together in the form of a sphere, homogeneous or heterogeneous; next of a spheroid; then of an irregular mass consisting of layers nearly spherical, and thus more and more approximating to the case of the earth. He then calculated the figure of the earth—first, upon the hypothesis of its being a fluid mass, and then on geodetical principles; and he shows that the mass now consists of nearly spherical strata, whatever its former history may have been; that, on the fluid hypothesis, the form of its surface and of all its internal layers must be oblate spheroids; and that the plumbline must be everywhere a normal to its surface. In conclusion, he asserts that no better explanation of the various phenomena can be conceived than that which the fluid hypothesis presents.

M. Trecul, in a recent contribution to the Academy of Sciences of Paris, describes a transformation which, if correct, will be equally interesting to the chemist and the botanist. While studying the Lactuca altissima, he separated, from the bark, by maceration, some beautiful green, needle-like crystals of globular and hemispherical forms, contained in the cellular laminæ. On further examination he witnessed the gradual conversion of grains of chlorophyl into crystals. In the same communication he reports certain experiments for which he claims the result, "that organic matter contained in certain cellules may, during putrefaction, be transformed into living bodies of a different nature from the generating species.

M. Bottger has published a new method of distinguishing cotton when mixed with linen. A piece of the suspected cloth, about eight or ten centimetres long and four centimetres broad, with the edges unravelled, is plunged into an alcoholic solution of aniline red, consisting of eight grains of crystallised fuchsine and sixty grammes of alcohol. After a few moments the cloth is withdrawn from the bath, and washed till the water remains colourless. The cloth while still moist is placed in a little capsule containing ammonia, for several minutes. In a short time the cotton threads appear perfectly white, but the linen threads retain a beautiful rose colour.

At a recent meeting of the Academy of Sciences at Paris, M. Payen reported the results of his researches on the iodide of potassium, a compound now much employed in medicine, especially to counteract the injurious effects of certain businesses, such as painting and white-lead making. M. Payen shows how important it is that this compound should be free from the carbonate of potash, and not contain iodine in excess, in order that the physician may not be deceived in its action. M. Chevreul added some remarks, supporting M. Payen's views and suggesting inquiry into the purity of the medicines now employed by pharmaceutical chemists.

M. Carlevari, of Genoa, in a letter to the Abbe Moigno, editor of the *Cosmos*, says that he has totally renounced the use of carbonate of magnesia, giving the preference to the chloride of magnesium, which, when combined with small ordinary gas-flames and burnt in common air mixed with one sixth its volume of oxygen, produces the most beautiful light in the world. He states that he has constructed for the purpose lamps of a very simple principle and easy to manage, which he has applied to photography with great success.

In a paper read at the Franklin Institute, Philadelphia, by Mr. Albert Leeds, on the geography and geology of petroleum, he combats the opinion that the flow from the oil wells will eventually cease, and gives a statement of his reasons, based upon facts, for the statement that henceforth petroleum deserves to be ranked with coal and iron as a solid mining interest.

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RANDOM NOTES.

In dry air at 32 deg. sound travels 1,099 feet per second, and 1 foot more for every degree of the thermometer.

A fibre of silk a mile long weighs but 12 grs., so that there are 583 miles of fibre in a pound avordupois.

Melted snow produces about one-eighth of its bulk of water, hence snow 2ft. deep produces 3in. of water.

A phial of water, in freezing, parts with as much atomic motion as would make an equal bulk of gold white hot.

The river Jordan is said to discharge into the Dead Sea as many as six millions and ninety thousand tons daily.

The amount annually realised from jet ornaments at Whitby, including their gold and silver settings, is £50,000.

The coasts of England and Wales are officially considered as about 2,000 miles, Scotland 1,100, and Ireland as 1,300.

According to the commonly-received chronology the discovery of the silkworm in China was made about the year 2640 B.C.

In the arctic regions persons can converse at more than a mile distant when the thermometer is below zero, and the air calm.

Oxen require from five to six, and sheep from three to four times as long a period to add a given proportion to the weight of their bodies as pigs.

Echoes are distinguished when the time between delivering a sound to its return is more than one-twelfth of a second, and there can be no echo in less than 47ft.

The fall of the Ganges is four inches to the mile, and nine inches in the mile of land; of the Amazon four inches, and the land 6 75; and of the Nile six inches in 1,000 miles.

The presence of one hundred-thousandth part of phosphorus may be detected in a body by Mitscherlich's process; and Dr. Herapath has found it perfectly possible to discover the ten-thousandth part of a grain of strychnia in solutions.

When coal-gas is highly heated a compound called acetylene is produced. This is strongly illuminating, and forms an explosive compound with copper; thus explaining the cause of the apparently mysterious explosions of gas when passed through copper tubes.

Iron castings may be hardened, after finishing, by immersing them, when brought to a cherry red heat, in a solution composed of sulphuric and nitric acids and water.

MM. St. Clair Deville, Caron, and Troost, have succeeded in making rubies artificially. The violet red tint of these is said to be exactly like that of the most beautiful natural stones.

Indelible Writing on Zinc.—An ink that will afford an indelible writing on zinc may be made by dissolving eight parts of gum-arabic in three hundred parts water, and adding to the solution, in fine powder, thirty parts sal-ammoniac and eight parts lampblack. A quill pen must be used with it.

Management of Gas for Illuminations.—The unscientific management of gas for illuminations has given rise to all the evil consequences which arise from over-crowding, since one gas-burner vitiates as much air as five human beings. When, therefore, large quantities of gas are burned, great attention should be paid to ventilation.

Plating Copper and Tin.—Copper, tin, &c., may be plated, or when plated, repaired, by moistening the places which are to be covered with silver with a solution of cyanide of silver and potassium; then applying to the same places finely-powdered zinc, and rubbing them with a brush. Iron after having been covered with copper, by means of a solution of cyanide of copper and potassium, and the application of the finely-powdered zinc, may be silvered with the cyanide of silver and potassium and the zinc, as before.

Chemical Science in Germany.—Such is the appreciation of chemical science in Germany that, at the present time, two large chemical laboratories on the most complete scale are in course of being erected at Berlin and Bonn, at the expense of the State. They will cost, it is said, about seventy-five thousand pounds.

Strengthening Cast-Iron.—Cast-iron is rendered very strong and tenacious by adding to it, in a state of fusion, from twenty to twenty-five per cent. refuse malleable iron, and stirring the mixture with a wooden rod. Throwing into this, while melted, some of a mixture which has been made by adding from twenty to twenty-five per cent. tin to cast-iron, heated until it begins to melt, affords a tenacious and compact alloy, which takes a fine polish.

Electricity, in excess or deficiency, is said to disturb the formation of crystals; and a thunderstorm has accelerated tardy crystallization.

Artificial Whetstone.—A good artificial whetstone may be formed by grinding the refuse fragments of lithographic stone in a mill, thoroughly mixing the resulting fine powder with powdered emery, borax, and nitre. The mass is next formed in the shape of the intended whetstone, then subjected to strong pressure in a hydraulic press, and finally exposed to a high temperature, which imparts to it the tenacity of stone.

Important Property of Potato-Peel.—Hitherto it has been supposed that catalytic action was to be found only in certain organic substances, such as diastase, emulsine, gluten, saliva, &c.; but it has recently been shown by Schonbein that it is to be discovered very generally in the organic kingdoms. Potato-peel, the root of the dandelion, lettice, &c., possess it in a very considerable degree. Potato-peel, in the raw state, placed for ten or twelve hours at a temperature of between 111° and 112° Fahr. in contact with starch, changed the starch completely into sugar.

Substitute for Ivory, Bone, Horn, &c.—Caoutchouc, or gutta-percha, is to be cut into small pieces, and, after having been well washed with water, is to be dissolved in chloroform, sulphuret of carbon, benzine, or turpentine. Chloroform answers best, if the product is intended to be white. The solution is to be effected in a well-closed vessel, and the mass is to be constantly shaken. A stream of chlorine gas is conducted into the solution, by means of a tube which reaches to the bottom of the vessel. As soon as the whole has assumed a uniform bright yellow colour, the transmission of the chlorine is to be discontinued, and the chlorinated product is to be transferred to another vessel, and well washed with alcohol. A solid, light, and white mass, which consists of caoutchouc, or gutta-percha, chemically changed by chlorine, is obtained. This white mass is to be swelled up by means of a little chloroform and constant agitation; and, according as it is desired to have a lighter or heavier material, or a more or less pure white tint, it is to be mixed with a greater or less amount of chalk, oyster-shell, marble, heavy spar, alumina, or sulphate of lead, in fine powder. The mixture is to be properly kneaded, and then formed into blocks, &c., of any required size in a press. This material may be obtained black, or of any colour, by adding a suitable colouring matter. The white, black, or coloured mass will answer well instead of ivory, bone, horn, ebony, &c., for buttons, handles for knives, or walking-canes, billiard balls, keys of pianofortes, &c., and is capable of being cut with a saw, &c., and turned or polished with ease.

CHEMISTRY.

An economic method of employing the magnesium light has been devised by Signor Carlevaris, of Mondovi. He stated, in a recent memoir, that when magnesium wire was ignited in atmospheric air, or pure oxygen, the most luminous effects were not manifest till a certain quantity of oxide had been formed, and was raised by the heat produced to an exceedingly high temperature. The light in this case, as in the combustion of carburetted hydrogen, as in that of hydrogen in contact with platinum, and as in the Drummond arrangement, is derived from the solid particles raised by the flame to a great heat—a heat which dissolves and volatilizes platinum, but leaves the oxide of magnesium solid, fixed, and intact. To raise this oxide to the temperature necessary to give the greatest light, it should be presented to the flame in as small a quantity and as large a volume as possible, which is done by employing a spongy oxide obtained as follows:—A piece of chloride of magnesium is exposed to the flame of the oxyhydrogen blow-pipe, in contact with a piece of carbon. The chloride of magnesium is rapidly decomposed, leaving the spongy oxide, which gives the light in question.

A new modification of gun-cotton has been prepared by M. Blondeau, and described by him in an important paper presented to the French Academy. This new kind of pyroxylene is said to possess a much higher explosive power than the ordinary kind, and, in addition to this, is unalterable, not only at the ordinary temperature, but does not decompose at 212°. To bestow these virtues upon gun-cotton, it is only necessary to take a good specimen of the usual sort, and expose it for about four hours to the action of ammoniacal vapours. The gun-cotton becomes yellow, and a compound formed with the ammonia, having no less a formula than C^{24}, H_{20}, O^{20}, $4(NO_5)$ (NO^4) (NH^3). This body, when dried, form a powder, having the valuable properties we have enumerated.—Vide *Comptes Rendus*, August.

THOMPSON'S PORTABLE ENGINE.

Almost every day witnesses the advent of some improvement or attempt at improvement in the application of steam power, and especially in the portable form, and the desire for simplicity and a reduction in the number of parts has led to attempts almost without number to construct an engine with a continuous rotary movement instead of a reciprocating one convertible to rotary movement by the action of a crank. It is obvious that a constant stopping and reversing must require greater weight and strength than a continuous movement in one single direction. Among the machines exhibited at the meeting of the British Association at Birmingham was a portable engine by Mr. R. W. Thompson, of Edinburgh, on the rotary principle. The boiler is vertical, having a cylinder of 3ft. in diameter by 6ft. in height, the internal fire surface consisting of a hemispherical bottom, with the heat spreading all over it by leading to a circle of vertical fire-tubes, passing through the water. To one side of this boiler is attached the engine, which shows externally as a horizontal cylinder, about 12in. in diameter by 2ft. in length, within which the pistons revolve, the entrance and exit of the steam being provided for by the action of external elliptical tooth wheels fixed on the revolving shafts, which, causing alternate faster or slower movement of the pistons past each other, opens and closes the passages. A drum-wheel on the axis of the cylinder carries a strap, which will put in motion any required machinery. The whole is supported on one pair of wheels, with a pair of shafts attached, and can be moved by one horse. The machine as shown was stated to be the equivalent of an ordinary eight-horse portable engine, and that the relative weights were, 30cwt. the rotary engine against 55cwt. on the ordinary plan, while the cost price of the former to the latter was in the same proportion. No flywheel is needed to keep up the movement, and there is an absence of all the vibrating motion induced by the reciprocation of ordinary engines. The principle is equally applicable to portable purposes or to boats or locomotive engines. The actual consumption of fuel for work done was not given to the meeting; but, assuming it to be the same per horse power, there is nothing in the wearing parts of the machine that may not easily be replaced, and at little cost. Every improvement of this kind, placing steam more and more within the reach of every one for all the common labour-saving purposes of life, is a gain to the community. It is probable that this engine, worked by a blazing fire of petroleum, will prove the best and simplest, as well as the cleanliest, moving power applicable to ship's launches, which is now found to be almost a necessity of modern steamships, economizing the strength of seamen by getting rid of the labour of the oar. Getting rid of weight in this machine is a very important matter, by allowing a larger amount of fuel, as well as facilitating the hoisting in and out.

Mr. R. Williams, late agent to the Penllyn Slate and Slab Company, has had a gold watch and chain, with a purse of sovereigns, presented to him as a testimonial, on his leaving Festiniog for a new appointment at a quarry near Corris.

Completion of the Pneumatic Despatch Railway.—Last Tuesday morning a train of two trucks containing a quantity of goods was driven through the Pneumatic Despatch tubular line of railway from the central station at the Bull and Gate, Holborn, to the terminus on the premises of the London and North Western Railway at Euston.

A few months since we noticed the circumstance of pigs being fed on coal. It now appears as if humanity was destined to thrive upon the same kind of food. Dr. Dyes, chief physician to the Regiment of Hussars of the Royal Guard of Hanover, having observed that sea-coal given to pigs made them grew fat, conceived the idea that its therapeutic effects on man might be equally advantageous. He therefore administered some to such of his patients as complained of abdominal affections, and is said to have obtained excellent and speedy results from this treatment. The sort of coal he prescribes, is the Piesberge anthracite, which is found in large quantities near Osnabruck.

Wavy Lines on the Plate.—To obviate the tendency which some collodions have to form wavy lines when the plate is coated, the editor of the *American Journal of Photography* recommends the addition of chloroform, in the proportions of ten drops to the ounce. He says it is effectual, but we cannot say why it should be so.

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A meeting has been held in Fermanagh to further the improvement of the drainage and navigation of Lough Erne. The chair was taken by John Madden, Esq. Mr. Hassard produced several maps and plans of the Upper and Lower Lakes, and read a statement which proposed the lowering of the summer level of the Lower Lake 18 inches, and that of the Upper 9 inches, and leaving the rocks at Belleek as a self-acting water-weir.

Anti-dry Rot.—One of the best modes of preserving timber seems to be that recently invented at Antwerp. The timber is deprived of its vegetable juices and resins by steam or boiling water, after which, and while still hot, it is immersed in any cold preservative solution or dye, which it absorbs very quickly, and to such an extent as to become dense enough to sink in water. The process depends on the principle that porous bodies, when expanded by heat, absorb liquids while contracting under the influence of cold: and the injection is effected by means of it far more rapidly and more effectually than by any hitherto in use.

A Government Packing up.—The Commissioners of Public Works of Canada accepted on the 20th ult. the tender of Craig and Valliere, cabinet-makers of Quebec, to pack and transport to Ottawa the departmental and legislative effects for the sum of 15,800 dollars.

PATENT LIST.

(From the Commissioners of Patents' Journal.)

LIST OF SPECIFICATIONS, &c PUBLISHED DURING THE WEEK ENDING 7TH OCTOBER, 1865.

2841. Manufacture of steel castings, T. E. Vickers—8d.
2842. Excluding air in treating bodily injuries, M. Henry—4d.
2843. Applying rolling friction to axle boxes and journals, N. Bailly, C. Durand, H. G. Mesnard, and Z. Poirier—8d.
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2854. Printer's ink, J. Rowley—4d.
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2874. Sawing and adzing railway sleepers, H. Wilson—1s. 10d.
2875. Moulding and planing wood, H. Wilson—10d.
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2877. Furnace for welding tubes, J. Fisher—4d.
2878. Anchors, S. Sharp—4d.
2879. Brick and tile machinery, W. Snell—10d.
2880. Raising and drawing-off liquids, J. Behrends—4d.
2881. Horse hoes and drills, W. Sargeant—4d.
2882. Working guns, T. A. Blakely—10d.
2883. Purifying illuminating gas, A. A. Croll—4d.
2884. Carbonizing wood, M. Henry—8d.
2885. Letter and other balances, W. Clark—8d.
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2889. Creating and projecting cold vapours, S. Plesse—4d.
2890. Motive power, E. S. Jones—4d.
2891. Preventing accidents with steam boilers, J. Phillips—10d.
2892. Fire-arms and cartridges, J. G. Tongue—8d.
2893. Steam boilers or generators, A. M. Stott—4d.
2894. Purple dye, W. V. Wilson and J. A. Wanklyn—4d.
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2896. Paper pulp, J. Easton, junr.—1s. 2d.
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2903. Sewing machines, H. Willis and G. Rice—4d.
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2905. Vent pegs and valves, S Bourne—10d.
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2915. Reefing and furling sails, T. Snorey, and G. Gibson—4d
2916. Aniline colours, J. C. L. Durand—4d.
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2922. Mules for spinning, J. Paley and T. Rawsthorne—10d.
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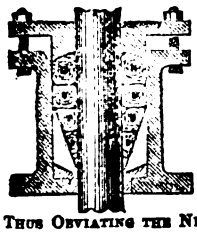

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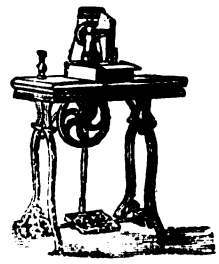

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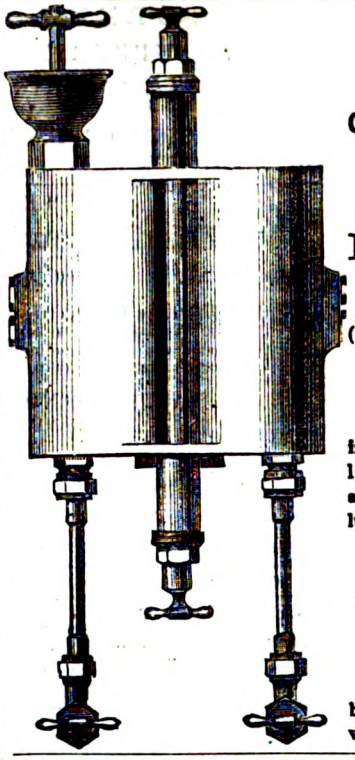

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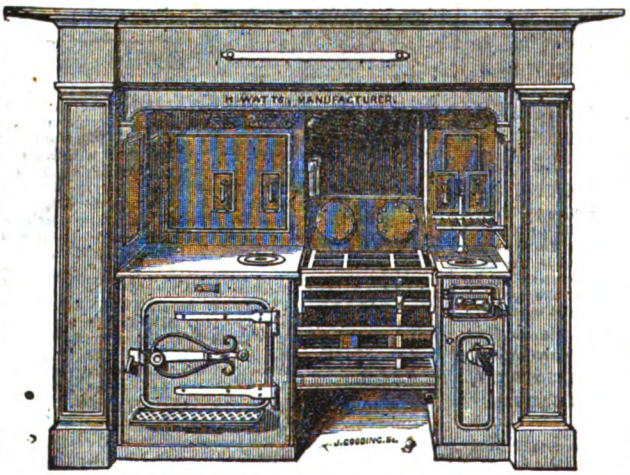

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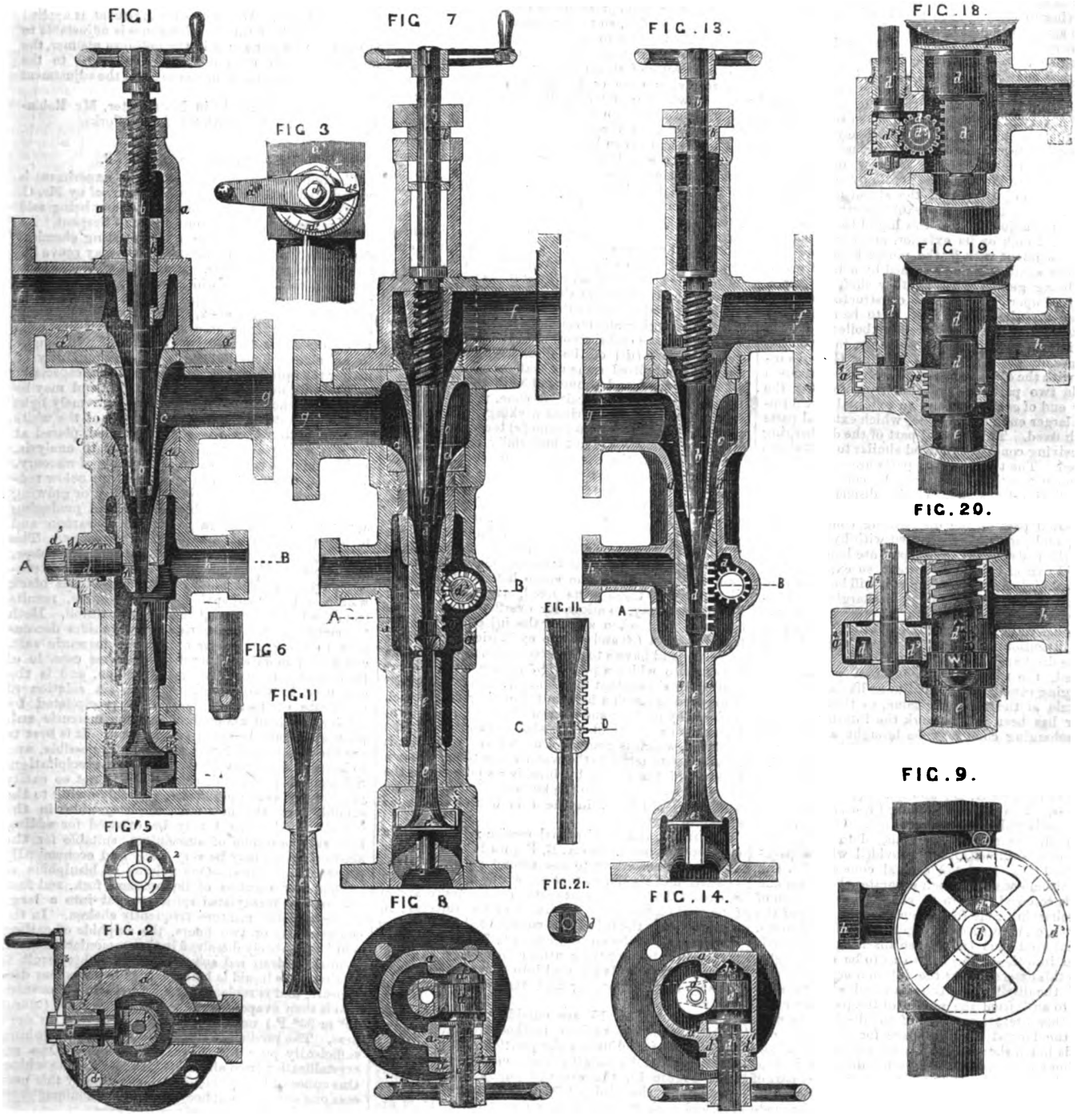

ROBINSON AND GRESHAM'S IMPROVED INJECTOR FOR STEAM BOILERS.

Hitherto "Giffard's injector" has been constructed in various ways so as to effect an adjustment of the annular spaces for steam and water or other liquid. One method has been by moving the hollow partition cone or nozzle between the steam and liquid, and the central spindle cone, the external hollow cone or nozzle (herein after termed the discharging cone) being fixed, and another method has been by connecting the hollow discharging cone and the hollow receiving cone or nozzle together, and arranging them with suitable packing, so that the larger end of the discharging cone could be adjusted to and from a fixed partition cone to regulate the space for water, the steam being still adjusted by the central cone spindle. By either of these methods, internal packing has been necessary, which it is the

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object of this invention to dispense with; also, to simplify construction, and render the apparatus more effective and less liable to get out of order.

The improvements consist, firstly, in arranging and combining the apparatus so that the hollow partition cone is fixed, and so that the steam is adjusted by means of the central cone spindle, as hitherto, and in arranging the discharging cone in a peculiar manner so as to be moveable without packing, independently of the receiving cone, which is fixed. By making the angles which come opposite the nozzle of the partition cone more obtuse than hitherto a shorter range is required for adjustment, and the apparatus acts perfectly, though the space between the two nozzles varies to the extent required for adjusting the space for liquid. The discharging hollow cone is made in two parts, an internal part forming the smaller, and an external the larger end of the hollow cone; the external is fixed, the internal part is moveable, and by the larger end of this part moving to and from the nozzle of the partition cone the space for liquid is adjusted.

The necessity for packing is dispensed with by arranging so that the movable internal part of the discharging cone will extend only a little past the nozzle of the partition cone when the space for liquid is fully open, at which point the jet or current has attained a very high velocity, and when so arranged we find the passing fluid has no tendency to escape between the internal and external discharging cone, but rather to suck in air, or to draw in any fluid which may overflow from the nozzle by accident, or an imperfect adjustment of the steam and liquid. Motion is given to this moveable internal part for effecting the adjustment of the liquid to the steam by a toothed rack on its exterior, gearing a toothed pinion or segment with it, the pinion being secured on a cross shaft, which is turned by a hand wheel or by being geared with another shaft having a hand wheel upon it. Injectors constructed as above described may be arranged so as to be readily adjusted to suit a high or low pressure boiler.

The improvements consist, secondly, in arranging and combining the apparatus forming Giffard's injector, with the discharging and receiving cones each made in two parts, an internal part forming the smaller end of each cone, and an external part forming the larger end of each cone, which external parts are both fixed. The internal part of the discharging and receiving cones is arranged similar to that above described. The two internal parts are connected so as to move together, and may be considered one piece. This internal part of the discharging and receiving cones is actuated in the same manner as the internal part of the discharging cone, as described, and packing is dispensed with by arranging so that the ends of the internal part are kept opposite the rapid part of the jet or current, so explained.

In some high-pressure injectors it will be an advantage if the space between the discharging and receiving cones or nozzles can be closed after the injector has been brought into operation. This part of the invention consists in constructing injectors with the discharging cone arranged and actuated as described, the nozzle of the internal part of the discharging cone being formed to fit like a valve into the nozzle of the receiving cone, so that when the injector has been got to work the internal part of the discharging cone may be brought against the nozzle of the receiving cone, and by this means the communication with the atmosphere may be closed.

Fig. 1, is a longitudinal section; fig. 2, a cross section in the line A, B; and fig. 3, (partly) an outside view. The external casing (a, a^1,) is formed in two parts united by flanges (a^3). One part (a) of the casing is screwed and bushed to receive the central cone spindle (b), and provided with a packing gland (b^1) round the central cone spindle, and the partition cone (c), which separates the steam and liquid is screwed so as to fit exactly in the centre of the discharging cone (d), when the two parts of the casing (a, a^1,) are secured together by their flanges. The external part (d) of the discharging cone is secured into the casing (a_1) so as to be steam-tight, and in this external part the internal or nozzle part (d^1) of the discharging cone is fitted so as to slide freely to and from the nozzle of the partition cone. When this internal part (d^1) of the discharging cone gives the largest annular space for liquid, its end extends but a short distance past the nozzle of the partition cone (c), and the external diameter is kept as small as possible, so as to be opposite that part of the passage where the jet or current has attained its greatest velocity. Should the external part be made much larger in diameter, so as to terminate opposite that part where the current is moving at a slow speed, there will be leakage, and internal packing would be required, which it is the object of this invention to dispense with. The internal or nozzle part (d_1) of the discharging cone is shewn detached in fig. 5. It is adjusted to regulate the water space by a crank pin (d^2), which fits into a groove formed across the exterior of the nozzle, as shewn in fig. 5 and fig. 2. This crank pin is made upon the end of a short stud or shaft (d_3), which has a collar upon it fitting a recess in the casing, as shewn. The short shaft is kept in its place by a screw gland (d^4), between which and the collar upon the short shaft packing is placed, and by means of the screw gland sufficient friction can be put upon the short shaft to prevent it from turning too easily. The crank pin (d^2) extends a little beyond the circumference of the short shaft (d^3), but by forming a notch at one side of the hole in the casing for the short shaft, it can be easily passed through. The short shaft (d^3) is turned by a handle (d_5), which may be formed with a pointer (d^6) referring to an index (d^7) fixed upon the exterior of the casing (as shewn in fig. 3), and this index may be graduated according to the minimum and maximum pressures of steam, for which the injector is intended, so that the nozzle part (d^1) when starting the injector to work may be placed as near as possible to the correct position suitable for any known pressure of steam to be used by the injector. The receiving cone or nozzle (e) is screwed into a ring (e^2), which carries the stalk of the valve (e^3), and this ring screws into the casing (a^1), so that the distance between the discharging and receiving nozzles (d_1 and e) can be adjusted when the injector is applied to suit high or low pressures. An end view of the ring and valve is shewn detached by fig. 4.

Figure 6, is a longitudinal section; Figure 7, a cross section on the line A, B, Figure 6; and Figure 8, partly a side view; of one modification of the improvements. The casing is made in two parts (a and a^1) connected by means of flanges (a) and screws, one part (a) of the casing is prepared to receive the central cone spindle (b) with its stuffing box (b^1), and the partition cone (c), as shewn, and the other part (a^2) is prepared to receive the external parts (d and e) of the discharging and receiving cones, and the valve (e^3) fitted at the end thereof, as shewn. The internal or nozzle part (d^1) of the discharging cone (d) is arranged and fitted same as that already described, but is continued and connected with the internal or nozzle part (e^1) of the receiving cone, which slides to and fro freely, and is without packing. The internal nozzle (e^1) of the receiving cone (e) terminates where the jet or current has not materially diminished in velocity, so that there is no pressure of fluid tending to escape between the surfaces of the internal and external receiving cones or nozzles. The internal nozzle (d^1 and e_1) of the cones may be formed in two pieces, as in Figure 6, or in one piece, as in Figure 9, a longitudinal section, and Figure 10, a cross section at c, D, Figure 9. The discharging and receiving nozzles are made at their terminations of the same form and with the same space between them as in injectors with these parts fixed, the metal being shewn cut away, to allow for overflow, and for the escape of fluid when starting the injector. The internal nozzles (d^1 and e^2) are cylindrical upon their exterior, and have a toothed rack formed thereon, as shewn, into which a pinion (d^2) gears upon a short shaft (d^3), shewn best in Figure 7. This shaft (d^3) is inserted through a hole in the casing (a^1), which is closed by packing and a screw gland (d^4), as shewn. Upon the exterior end of the shaft a hand wheel (d^5) is placed, which is graduated upon its edge, so that it may be set to regulate the water space to any known pressure of the steam, by bringing a point upon the index corresponding to the known pressure opposite a pointer (d^6) fixed in the side of the casing, as shewn in Figure 8.

Figure 11, is a longitudinal section; Figure 12, a cross section on the line A, B, Figure 11, which shew an injector according to the second part of the invention, and similar to that shewn by Figures 6, 7, 8, except that the external parts of the cones (d and e) form part of the body or casing of the injector; in other respects the injector is constructed in the same manner as that shewn by Figures 6, 7, 8, except that part (a) containing the central cone spindle (b), and partition cone (c) is screwed into that part (a^1) containing the discharging and receiving cones and valve.

Figures 13, 14, 15, are outside views, partly in section, shewing various methods for giving the movements for adjusting the position of the internal nozzles of the discharging and receiving cones.

In Figure 13, the worm (d^9) upon the shaft (d^{10}) gears with the pinion (d^2) that engages with the toothed rack upon the nozzle part (d_1). It is arranged with a screw gland stuffing box (d^4), as shewn, the part (a^4) forming the bearing and the stuffing box, and carrying the axis (d_3) of the pinion (d_4) being secured to the side of the casing (a^1) by screws.

The injector shewn by Figure 14 is somewhat similar to that shewn by Figure 13, the worm being enlarged in diameter, so as to gear directly with the teeth upon the nozzle (d_1), which is prevented from turning by a screw (y), the head of which moves up and down in a slot in a projection from the external discharging cone. The worm (d^9) is inserted through a slot in the casing (a_1), and is covered by a cap (a^4) secured by screws.

Figure 15 shews an arrangement somewhat similar to Figure 14, except that in place of the worm (d^9) a toothed pinion (d^9) is fixed, which gears with a pinion (w) fixed upon the internal nozzle (d_1), to which it gives rotating motion, the internal discharging nozzle (d^1) being made to screw into the external discharging cone (d). In each of the injectors, f represents the inlet for steam; g, that for water or liquid; and h, the overflow orifice.

Figure 16 shews the manner in which the third part of the invention is carried into effect. The nozzles (d^1 and e) are formed as shewn, and ground to fit like a valve. When the arrangement is applied to injectors where the partition cones is adjustable to regulate the water space in the ordinary manner, the moveable nozzle need not extend so close to the nozzle of the partition cone as to effect the adjustment of the water space.

The inventors reside in Manchester, Mr. Robinson being connected with the Atlas Works.

PHARAOH'S SERPENT.

The following account of a curious experiment is contributed to the *Pharmaceutical Journal* by Mr. C. H. Wood:—"A very curious toy is now being sold in Paris, under the name of Pharaoh's Serpent. As this toy really constitutes an interesting chemical experiment, perhaps an account of it may prove interesting to your readers. It consists of a little cone of tinfoil, containing a white powder, about an inch in height, and resembling a pastille. This cone is to be lighted at its apex, when there immediately begins issuing from it a thick, serpent-like coil, which continues twisting and increasing in length to an almost incredible extent. The quantity of matter thus produced is truly marvellous, especially as the coil which so exudes is solid, and may be handled, although, of course, it is extremely light and somewhat fragile. Having a little of the white powder, with which the cones are filled, placed at my disposal by a friend, I submitted it to analysis, and found it to consist of sulphocyanide of mercury. This salt, when heated to a temperature below redness, undergoes decomposition, swelling or growing in size in a most remarkable manner, and producing a mixture of mellon (a compound of carbon and nitrogen), with a little sulphide of mercury. The resulting mass often assumes a most fantastic shape, and is sufficiently coherent to retain its form; it presents a yellow colour on the exterior, but is black within. The 'serpent' shape, of course, results from the salt being burnt in a cone of tinfoil. Both the mercurous and mercuric sulphocyanides decompose in the same manner; but the mercuric salt, containing more sulphocyanogen, seems capable of furnishing a larger quantity of mellon, and is the one used in the French serpents. A solution of pernitrate of mercury is readily precipitated by sulphocyanide of ammonium, and the mercuric sulphocyanide may be easily so prepared. It is best to use the mercurial solution as strong as possible, and to keep it in excess throughout the precipitation. Solution of perchloride of mercury is not so easily precipitated as the pernitrate, probably owing to the solubility of the mercuric sulphocyanide in the chlorides. Perhaps I may be excused for adding that sulphocyanide of ammonium, suitable for the above purpose, may be very easily and economically prepared as follows:—One volume of bisulphide of carbon, four volumes of liq. ammon. fort., and four volumes of methylated spirit are put into a large bottle, and the mixture frequently shaken. In the course of one or two hours, the sulphide of carbon will have entirely dissolved in the ammoniacal liquid, forming a deep red solution. When this result is attained, the liquid is boiled until the red colour disappears, and is replaced by light yellow. The solution is then evaporated at a very gentle heat (about 80° or 90° F.) until it crystallises, or just to dryness. The product is sulphocyanide of ammonium, sufficiently pure for the above purpose. One recrystallisation from alcohol will render it quite white. One ounce of bisulphide of carbon yields by this process one ounce of sulphocyanide of ammonium."

A Convex lens burns at 25ft. under the surface of the sea in a diving bell

The first known use of the rail in railways is due to Beaumon, in the year 1639.

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ANSWERS TO CORRESPONDENTS.

A. O B.—Perhaps the following will suit your purpose. Stirling's and Ericsson's caloric, or hot-air engines are much used in the United States, and the action may be briefly described thus:—The chamber in the caloric-engine, through which the hot air passes, is filled with fine wire nettings, placed side by side, to the thickness of twenty inches. On leaving the cylinder, the air, after doing its duty on the piston, is made to pass outwards through this chamber. In its passage, a quantity of its heat is abstracted by the metal network, and given up to the returning air, which passes inwards through the same chamber. The returning air, with a slight accession of heat from the furnace, produces another effective stroke of the piston—thus fuel is saved. In the ship *Ericsson* the engine consisted of two pairs of cylinders, connected in their action, but not placed side by side. Each pair was composed of two cylinders—the lower one (the larger) being called the working cylinder, the upper the supply cylinder. The diameter of the working cylinders was 168 inches, that of the supply 137 inches each. This enormous bore was found insufficient for the work. We believe several are at work in the worth of Scotland, the chambers being of very thick cast-iron.

James Hassay.—On tinfoil, properly disposed on a perfectly flat surface, pour mercury, which gently rub in with a hare's foot. It soon unites with the tin, and "quickens." Your plate of glass should then be cautiously slid on the tinfoil, so as to slide off the superabundant mercury. Then place weights on the glass, which will quickly adhere to the tinfoil. The glass should be very clean—dirt prevents adhesion. (2.) The surface to be gilt must be carefully covered with a strong animal size; when dry repeat with a sufficient number of layers of the same size mixed with washed chalk. When this is dry, a thickish layer must be added, composed of size and Armenian bole, or yellow oxide of lead. While this is yet moist, lay on the gold leaf, which will adhere on being pressed with the cotton ball; and, before the size is perfectly dry, burnish with an agate or dog's tooth fixed in a handle

Old Charlie.—Thanks—see the "Queries." We will *not* forget your suggestions.

R. S. B. (C. Ct.).—You will find a little "smeltery" described a fortnight back, with a small illustration. If that won't suit, write again.

H. Harding.—With a flint stone, then on a willow wheel, fed with pumicestone.

W. H. H.—Fine emery paper, with oil. For cylindrical surfaces the paper is wrapped around a parallel piece of stick. Additional lustre is given with woollen cloth, oil, and rottenstone.

W. R. (Newcastle-on-Tyne).—The price charged for the printed specification, which will be sent to you by Mr. B. Woodcroft, from the office of the Commissioners of Patents, Southampton-buildings, on receipt of postage stamps. Over 5s by money order.

James Wallace.—We made a memorandum of your wants, but have not yet laid hold of the article.

W. Mechanical.—If you inquire where you saw the cooking apparatus they will tell you where the article is made; or may be able to get you one. If not, write again.

T. R. Westow.—They have no cause for complaint, as you say; but there is a great demand for the article. The article you note is finished. Your queries in another place.

Amateur Painter.—See letter in another column.

J. G.—By means of Tyler's force-pump, sometimes. If you require one, send to him at Newgate Market, and he'll return you a catalogue.

W. Taylor.—There is the "Wanzer" Machine Company (Limited) at 4, Cheapside.

T. G. Maugh.—This query has been answered once or twice, we think, already, in this place. We insert your query in another place, however

Hercules.—If you look at the advertisement columns you will find your wants supplied. The parties generally keep small models on sale. You might also send to Mr. West, 92, Fleet-street

One who Believes his Light, &c.—See Mr. Smith's letter in another column, and endeavour to see the engine. If you cannot, we'll insert your letter.

Plumber.—We will endeavour to do so. You have no conception how difficult it is to get at it

E. G. C. (East Dereham).—We think some knowledge of drawing and mechanics, and of the lathe, is considered of value; but we think, if you mean trying to get in, that it would pay you to visit the town, and make acquaintance with two or three of the men.

Brassy.—Will endeavour shortly to meet your wishes.

Constant Reader (Dundee).—Your query respecting the chuck inserted elsewhere. Concerning the books, apply to Mr. Alvey, Swedenborg Society Publishing House, Bloomsbury.

H. H. H.—If you acquire the best, send to Holtzapffel, in Long-acre. In second hand, advertise. Prices vary.

W. Stocks.—Send to Spon, Bucklersbury, for their catalogue.

Civa.—Will have seen ere this that the promise has been fulfilled. For the price of Mr. Muir's lathe, send to him, at 10, John-street, Adelphi.

J. Nash.—Read up the list in a recent number, and send to Spon's, Bucklersbury, for a catalogue, and to Weale, Holborn.

J. L. (Constant Reader).—Will endeavour to supply your wants.

R. Trevor.—The index and cases are to be had at the office. You don't require much, certainly; were all our correspondents to want half as much, we should require—well, £20,000 a year to pay for it. What we can give we will.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

NOTICE TO ADVERTISERS.

Advertisers in this journal are respectfully informed that the Collector from the office, 162, Fleet-street, will call upon them for a settlement of the amounts due for the insertion of advertisements. The Collector will in every instance hand in a printed receipt for the sum paid to him. Advertisers are particularly cautioned against paying money without receiving the printed receipt.

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TO ADVERTISERS AND CORRESPONDENTS.

*** In future all Advertisements and Communications for the Editor to be sent to
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Post-Office Orders to be made payable to George Maddick, Fleet Street Branch.
All Advertisements should be sent to us not later than Friday.

The English Mechanic.

FRIDAY, OCTOBER 27TH, 1865.

LAND AND BUILDING SOCIETIES.

A very interesting series of papers was read in the Economy and Trade department by the Social Science Congress, on the subject of our caption; and we have to regret that the space at our command will not permit us to do more than give a short digest of each of three. The first was by F. Biggs, Esq., F.S.S., and directed attention to one of the greatest evils in the production of disease, poverty, and pauperism—viz., the state of the dwellings of the labouring classes, and the insufficiency of home accommodation. The house had very much to do with the manners, the habits, and morals of the people; where the decencies of life could not be preserved the moralities were impossible. The evil of overcrowding in dwellings was great in large towns, and had at last extended to the villages and hamlets, and through the deficiency of home accommodation it existed throughout the land. He described at length the origin and history of building societies, and of freehold land societies, which he warmly advocated as the means of remedying the evils of overcrowding. The benefits they conferred upon a working man were these—they gave him higher interest than a savings bank would, with equally good security, if he were careful in his selection; he had all the advantages that the merchant or trader had from a bank, and he was able at any time to employ his deposits in the purchase of a piece of land. He objected to the monopoly which existed to so great an extent through the land, of the country being held principally by the wealthy, which interfered with the proper enlargement of our towns. He suggested that a sort of Permissive Act should be passed by which any municipality or local authority could take land for extension of buildings or for new buildings anywhere within the jurisdiction of any local acts which empowered them to pave, light, or drain. He further recommended that an easy and economic mode of transfer should be introduced to supersede the present cumbrous, tedious, and expensive mode of conveyance—such a system as would render the transfer of land as easy as the transfer of railway shares.

Mr. S. B. Anty's paper next claims attention, and in it he set forth the various advantages accruing to members of such societies, thus: The politician saw in them the power of increasing the number of electors by acquiring, through the medium of these societies, a small freehold or adequate leasehold property. Unquestionably this was a noble object to be attained, and gave a standing in society, and enabled them, though only a small unit of the great social family, to raise their voice and support in the election of those best qualified to direct the affairs of the nation, and produce contentment and happiness to its entire population. The essayist having alluded to the advantages conferred upon the working classes by inspiring them with habits of thrift remarked that the industrious were actuated by a variety of motives in joining those societies. There were some who cared nothing for political franchise, but who desired social position. They observed the advantages accruing from the possession of a little capital, and although thirteen years might seem a long time over which to be paying money, they knew that if adverse circumstances overtook them they could withdraw their money before the expiration of the time. Though the principles of working these societies were well known, it behoved the societies to have men of experience as managers—men understanding the science of accounts. Mr. Anty detailed the mode in which the operations of these societies was most successfully conducted; and when such was the case the result was a great pecuniary benefit to investors.

Mr. H. W. Ibbotson, Sheffield, spoke on the benefit of building societies in general, with some suggestions on the desirability of amending the law respecting them. Having sketched the history of these societies and their present position, Mr. Ibbotson selected a few of the most general benefits accruing from them, referred in detail to their practical operation, and lastly offered suggestions on the amendment of the law respecting them. Upwards of 2,000 societies were registered under the 6th and 7th Wm. IV., cap. 32, up to 1850, and the societies had since then still greatly increased. The advantages of the societies were these:—Houses might be purchased by a slight increase of payment (by small monthly instalments) on what would be demanded for the annual rent, and premiums or fees for apprenticeship, marriage endowments, and provisions for old age or for any other object whatever might be secured by the same medium. Such societies had tended in a remarkable degree to foster the habit of economy and carefulness, and they had extended the system of co-operation with the greatest advantages to the working classes. Mr. Ibbotson next spoke of the facilities and advantages for lending and borrowing in connection with the societies, and then suggested the following amendments in the law: It would be advantageous, he thought, to repeal the clause of the Act which limited the amount of each share in building societies to £150, as it did no good, but on the contrary hampered the society in its operations; he also suggested the repeal of the clause providing that no member withdrawing his shares before the termination of the period originally prescribed, should be permitted to take any profits accruing on such shares. He thought the exemp-

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tion of certain legal documents from duty on such societies was not so comprehensive as it might be, and suggested that it ought to be complete, and to be applied to every description of document; he advocated the desirability of giving the directors of societies power to take personal security. He contended that the societies ought to have full power to raise loans without evading the Act (as they were compelled to do) by issuing certificates of paid-up shares; and finally, he suggested, as to the redemption of mortgages, that the precise mode in which amounts to be charged to a borrower on redemption should be calculated, and thus prevent the possibility of any future litigation on the subject.

BIRTH AND GROWTH OF THE IRON TRADE.

By James Robertson, Esq.

HISTORY is the portraiture of the past. It is a compound of philosophy and poetry; the philosophy affords us sound advice and lessons of wisdom, deduced from the experience of our predecessors, and confirmed by the transactions of bygone times. The poetry of history leads the imagination to realise a past state of affairs, and particularly pictures forth the life and manners of those who have transmitted the discoveries of civilization, whose names are hallowed in the arts and sciences as benefactors of their race. The historian of a kingdom such as this has a great task before him, a subject with many ramifications, embracing varied and conflicting interests, and demanding that each individual branch of manufacture should have a distinctive individuality, showing how order arose out of chaos, showing how our mechanical power and commercial industry arose, showing how the iron arose from a few hearths in remote and solitary forests to an importance truly wonderful from their colossal proportions, and to which the past history of ancient or modern times can find no parallel. I shall restrict myself to the commercial importance of the iron trade and its gradual and vast development, knowing that with a practical people like ourselves scientific discoveries, which have no real or commercial value, are seldom popular, and that the commercial value which the skill of the engineer has given to the iron trade has placed it in its present prominent position.

Manifold are the uses to which this metal has been applied—the ploughshare and the sword, the graceful needle and the ponderous anchor, the medicine of the physician administered to cure, and the deadly bal of—

"The mortal engines.
Whose rude throats the immortal Jove's dread clamour counterfeit,"

owe alike their origin to iron dug from "the bowels of the harmless earth." In the form of steel it has now become, in the form of crinoline, an important element in female dress, and in Berlin it has been manufactured into trinkets, earrings, and ornaments, the price of some of which reach the astounding figure of £2,700 per cwt.

Iron must have slumbered in the earth long before the creation of man, yet if we go to Holy Writ we find that not many generations had passed away ere Tubal Cain became an artificer in brass and iron. Gold, silver, and copper are found in their perfect state, so that it required less cunning to discover these metals; still, the hidden wealth of the ironstone must have been early found out, since so soon after man's creation we have evidence of its existence as a metal. How it was discovered we have no evidence to show. Whether by revelation or science we can only conjecture; but science itself is a revelation. It is the sounding of the hidden secrets of Nature; it is the investigation by the inquisitive spirit of man of those immutable laws by which this globe is governed, and as man transmitted to his posterity his discoveries in art and science, posterity perpetuated the discoveries, whilst the means by which those discoveries were made were irretrievably lost. We find from the Sacred Volume that 1500 years before the Christian era Og, king of Bashan, had a bedstead of iron, proving that iron had, at that early period, been applied to domestic purposes. Goliath, the giant of Gath, had a spear-head of iron (B.C. 1044). There is also defensive armour spoken of about the same period, and Job says, "Oh! that my words were written with an iron pen, and cut in the rock, that they might endure for ever." Herodotus speaks of men skilled in science, brought into Greece by Cadmus (B.C. 1500), by whose abilities gold was discovered; they made arms and edge tools, and great fleets were built, which gave to Greece the dominion of the sea. The earliest writers on the manufacture of iron are Diodorus Siculus, and Pliny the elder.

(To be continued.)

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

BOOKS ON TURNING, &c.

Sir,—I copy for I. H. the title page of 26 in list. The art of double-counting on the lathe, by Capt. James Ash. —London, L. Booth, 307, Regent-street; and sold by Holtzapffel and Co., 64 Charing-cross, 1857. I obtained mine second-hand price 10s.

Bergeron, 11 in list, Messrs. Hachette, King William-street, Strand, would no doubt obtain for J. F. It was 30 francs, say 30s., in 1820, about 45s. in 1860, and is perhaps not obtainable by this time. Valicourt is fully equal to it, price 12s or 14s. English Indian ink will not have one of the essentials of the genuine. Five or six drops of hydrocloric acid and two of spirits of wine to an ounce of water, will stop the genuine from working off in "shading up."

H. C. can never have seen a cast-steel tool exposed to nearly melting heat and turn out fit for use; at about "cherry" heat is the right degree to work at, certainly never above red-hot. H. H.

P.S. In "lathe centres" one mans 45° is the other's 90°.

Sir,—In No. 26 of The English Mechanic for September 22nd, you answer J. Watson (Doncaster) by referring him to a book on "Parlour Magic," published by Beeton. May I ask the exact title and price of this work? I can find nothing like it in Beeton's Catalogue, or rather advertised list. Cagliostro.

Forest Lodge, Maresfield, Uckfield.

Sir,—I have only just noticed the reply of "Mephistopheles" to "E. McGurk," (No. 25), wherein he states, that "no clock will strike the same hour twice." This is incorrect. I have one by Robbin, of Hatton-garden, which will not only strike the same hour twice consecutively, but as many times as you please. In fact, by reason of its peculiar construction, it cannot strike wrong. W. J. F.

VELOCIPEDES.

The various inquirers on this subject will, if possible, be answered in our next.

THE BELLEROPHON.

Sir,—In answer to your correspondent W. G. W. in No. 29, in reference to the overrunning of the screw in the ship Bellerophon, I beg to submit my theory of the matter. The ship Bellerophon is fitted with a four bladed screw. The blades when viewed in a line with the shaft will show that the water from the front or cutting blade is thrown back to the other blade, which forms a dam for the water, and the screw being propelled at a greater speed than the water can free itself, it causes a round column of water to hold in between the blades of the screw, which immediately checks the speed of the engines; but the screw having previously gripped the water, a speed is given to the ship, and being heavily plated is not easily stopped and therefore overruns the revolutions of the screw; but immediately the vessel drops its speed the water leaves the confined parts of the screw, and the screw resumes its speed again to be pulled up in a like manner when the blade becomes waterlogged. I feel thoroughly convinced that if the screw had been run at a much less speed the vessel would have travelled quite as fast, and without overrunning its screw, as the water would have had time to leave the inner circle or confined parts of the screw. Now this I know from experience, having tried six, five, four, three, and two bladed screws, but none supersedes the three bladed screw placed on an angle of forty-five.

I have a working model seven feet long, fitted up with steam power, and can prove the truth of my assertion at any time. E. E. Colley, Engineer.

1, Mansion-villa's, Mansion-street, Camberwell-road.

THE AMERICAN STREET RAILWAY SCHEME.

Sir,—I can scarcely believe that the New Yorkers will care to avail themselves much of the ingenious elevated railway, invented by Mr. P. Andrews, and described in The English Mechanic; albeit, the inventor has kept three things constantly in view. It appears to me that the safety of both those who travel in the cars and under them has been constantly excluded from view.

An upright revolving shaft is a dangerous thing, even when in a mill among mechanics. How much more so when projecting from the footpath of a crowded thoroughfare? For the inventor's special advantage I will suggest carrying this shaft up through the inside of the supporting pillar; it would then be out of sight, and prevented alike from doing damage or being damaged itself. Even then, however, I am afraid the item "compensation" for accidents would soon swallow up a company's capital. My card being enclosed, I here subscribe myself W. H. N.

Chard, Oct. 17th, 1865.

OUR SUBSCRIBERS' NOTES AND QUERIES.

Substitute for Silver.—What is a good substitute for the silver parts of graduated instruments? It should be white, not easily tarnished, not easily bruised, and soft enough to engrave upon, not expensive, and to melt at such a temperature that an amateur can work at.—Old Charlie. [Try 90 tin, 7 antimony.]

Aquarium Fountain.—What is the simplest? How made. —W. Brown.

Electric Clock.—In p. 244 is an illustration of an electro-magnetic clock: of what is the magnet M composed? G. Phillips.

Assaying.—How are iron ores and galena assayed?—R. W. Westow.

Moulds.—The best way to make elastic moulds for undercut work in plaster casting; also, what is the white hard varnish for plaster casts?—Amateur Caster.

Safety Valve.—What is the method of ascertaining the pressure of steam a boiler can bear by the safety valve?—T. G. Maugh.

Waterproofing.—Can anyone give me a recipe for waterproofing umbrellas without taking away their lightness?—Chips.

Telescope.—The cost of a telescope object glass, 12in. in diameter, 12ft focal length, also that of the small tube with the eye glasses fitted complete; the best place to get them, and any information to assist an amateur to get one up cheaply—Satellite.

Horse-Shoe Magnet.—What is the size of the iron, and the kind and number of wire for a horse-shoe electro-magnet to lift 500lbs. or more, and the size and kind of battery required?—W. C. H.

Plating.—What is the best way to silver-plate small things in jewellery, by simple immersion or otherwise, to stand burnishing, and the colour?—G. S. L.

Soldering.—How can I solder very small things in jewellery, without fire? Is there not a chemical process in Birmingham?—Geo. Smith.

Tortoise-shell.—How is tortoise shell made to join without putting on a plate or rivetting?—W. H. C.

Steel Wire Gauge.—Will any reader favour me with a table of the gauges of steel wire, with the diameters?—R. T. S.

Chuck.—Wanted, a description of a chuck to hold brass rod for turning in a hand lathe.—R. T. S.

Well Boring.—As I am going shortly to New Zealand I shall be obliged to anyone who can tell me how a tube can be driven to 20 or 30 feet, and if any and what tools are used. —J. W.

Dissecting Microscope.—What is the price of, and where can I obtain, a Collins' dissecting microscope?—J. Whitehead.

Oval Chuck.—I shall be obliged to your volunteer correspondent for his description of the oval chuck.—Eccentric.

Microscope.—How can I convert a magic lantern into an opaque microscope, such as exhibited at the Polytechnic? —J. W.

Depositing.—Why is it I cannot get a good electrotype deposit—it being a brown spongy mass, instead of metallic copper? Can iron be deposited, and by what method?—J. W.

Slide Rule.—I have bought one, and don't know how to use it. Will anyone tell me how?—Young Mechanic.

Utilizing Waste.—To what purpose can I put cotton waste used to clean machinery with; also, old vulcanised india-rubber steam joints, and india rubber that has been used in muriatic acid?—Woden.

Sheet Gutta Percha.—Where can I procure really good sheet gutta percha, that will not rot readily.—York, Jr.

Wind Engines.—Wanted, details of construction of the small wind engines used for driving chaff cutters and other small machines?—Vent.

Paddle Wheels.—What advantage is there in splitting the floats of a paddle wheel in two, and putting one half on each side of the arm, and the disadvantage, if any?—Wm. Swinburn.

Opalescence.—Will any one inform me the manner in which opalescence or iridescence is produced, as used in ornamenting surfaces.—Flanders Owen.

Standard Barometer.—Wanted, the relative proportions between the bore of the tube and the cistern of a standard barometer—say, the tube being ⅛in., what is the area of the cistern. Torichelli.

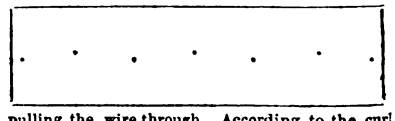
SPEED OF ROLLERS.

Sir,—Which is the best proportion of speed for the rollers of frames used in cotton spinning. Some makers run the back roller the same speed as the middle, while others have a draft of one into two, or more. What is the best proportion to run the middle roller, when, for instance, the back goes one, and the front six. Cotton.

STRAIGHTENING WIRE.

Sir,—I have straighened wire by boring a hole in a small log, looping the end to a bar, attaching a horse thereto, and so pulling it through. R. Mitchell.

[Another method is to place pins on a board, thus:—



and pulling the wire through. According to the curl, so are the number of points and their closeness.]

SMALL CASTINGS.

Sir,—I am much obliged to Mr. McGurk for his description of a small furnace, and I beg to ask him to describe a crucible suitable for it—if I can make them, or where I can get them—price, time of wear, &c., &c.

Amateur Mechanic.

TO HARDEN STEEL.

Sir,—In answer to M. C. B., he can harden steel by heating it in melted lead, and quench in oil. To temper, first polish or scrape it white; then hold it over the gas till it is let down low enough. W. H. E.

Sir,—A shoemaker's bench can be obtained at Mr. J. Sparkes Hall's, 308, 310, Regent-street, W.; and shoemaker's sewing machines at St. George Machine-works, St. George's-road, S. Prices, £9 and £10 each. B. M. T.

PAPER BAG MACHINERY.

Sir,—In answer to the query of J. H. B., under head of Paper Bag Machinery, call at the address below, where a new and simple machine for the above purpose has just been patented, and the machines will shortly be in the market. B. Browne & Co.

Patent Office, 49, King William-street, E.C.

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ATLANTIC CABLE.

Sir,—Your correspondent Edmund Dear, in No. 29 proposes to fill his buoy for under-running the Atlantic Cable with compressed air, evidently with the idea of giving it a greater buoyancy. But instead of lessening the specific gravity of the buoy by filling it with condensed air, he absolutely increases it. He might compress the air to such an extent, that it would weigh heavier than the water it displaced and, as a matter of course, the buoy would then sink to the bottom. I extract the following from Dr. Lardner's work on "Hydrostatics and Pneumatics," which may be useful to him:—

"Every increase which is given to the quantity of air contained in a vessel (by compression or condensation) produces a corresponding increase in its weight, and every diminution of the quantity of air it contains produces a corresponding diminution in its weight."

With regard to the other part of his apparatus, I think that if there were any kinks in the cable, or barnacles and seaweed adhering to it, there would be much difficulty in passing the cable through the groove in the sheave; and should any sudden hitch of this kind occur, the cable would very likely break before the accompanying steamers could stop—to say nothing about the almost insurmountable difficulty of keeping two steamers in a sea way, on an exactly parallel course, and at the same rate of speed.

W. G. W.

IN ANSWER TO "J. E. M." "T. HARRISON," AND OTHERS.

Sir,—In answer to "J. E. M.," in your last number, he is quite right in saying that his pistons will be pushed forward by steam in proportion to their effective, not superficial area, but, in all the cases he has shown, the effective area is the same, viz.:—

The diameter of the cylinder, and the different shapes cannot possibly make any difference in the action of the steam, except the one marked F, and in that case the effect would be to wear one side of the piston immensely faster than the other.

In reference to Jas. Morrison's letter on "Lap and Lead," the subject being very interesting and important, I should like a little explanation.

By "throw of the valve," does he mean its travel, or half its travel, or, in the event (as in common slotted links, with eccentric rods connected at the ends) of the throw of the eccentric not corresponding to half the travel of the valve, which dimensions should be adopted as a basis for the construction of the diagram. There must be some mistake at the end—"the line G, J, F = the angular advance of the sheaf." This cannot be the case, or the eccentric would be at right angles to the crank. I suppose J. M. means that if the line of the crank be at right angles to G, I F, then A, G, C, will be the proper position for the eccentric.

In answer to Eccentric's question, I should say that rules to find the lead are useless. I know in engineers' shops it is seldom settled scientifically, but varies according to the size and nature of the valve from $\frac{1''}{32}$ to $\frac{3''}{16}$. I can vouch, however, from experience, for the accuracy of the following table for finding the lap.

To cut the steam off when the piston has passed through

$\frac{1}{2}$	$\frac{7}{12}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{11}{12}$

of its stroke, multiply the given stroke of the valve by:—

.354	.323	.289	.250	.204	.177	.144

and the product, less half the lead, is the lap required.

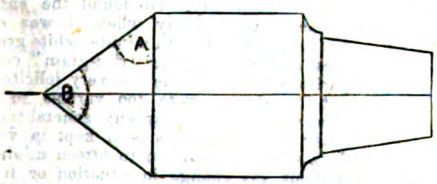
In answer to T. Harrison, "Willis's Mechanics" has been out of print for a good many years, and is very scarce; at least, I have not been able to procure a copy after a most diligent search through all sorts of book shops.

In answer to Tyro—the use of two, three, or more threads (of the same pitch) on a high-pitched screw is to lessen their liability to strap, which is done just in proportion to the number of threads.

Hoping this letter may be of as much use to some of your subscribers as their answers have at various times been to me.

A. K. B.

P.S.—Kilmarnock, Mr. Jackson, &c., are at cross purposes about the angles of lathe centres. The former refers to the angle at A, the latter to that at B.



It is evident that if A = 45°, B must = 90°, as the three angles in any triangle are equal to two right angles.

MAHOGANY DYE.

Sir,—In answer to X. Y. Z., who requires a dye for mahogany:—

First, plane the wood (which should be of a close grain) perfectly smooth. The wood is then to be rubbed with diluted nitrous acid. Afterwards, one ounce and a half of dragon's blood, dissolved in a pint of spirits of wine, and one third of that quantity of carbonate of soda, are to be mixed together, and filtered, and the liquid in this state is to be rubbed, or, rather, laid on by a soft brush. The surface will assume the appearance of an artificial mirror; but if the polish becomes less brilliant, by rubbing it with a little cold drawn linseed oil, the wood will be restored to its former brilliancy.

E. H. Honeysett.

MOMENTUM.

Sir,—I wish to know the weight of rim of a fly-wheel for an engine, the cylinder 8in. dia., 8in. stroke, and fly-wheel 2·5ft external dia., 150 revolutions per minute. I have tried the rules of Burgh, Molesworth, Bourne, and others, and find them to vary from 1 cwt. to 7 cwt.

Wishing to try by the law the power or momentum of moving bodies, I found in Bourne's catechism, (4th edition, 1856, page 10), "That the power inherent in a moving body of any weight, is proportionate to the square of the velocity. Of two balls, therefore, of equal weight, one moving twice as fast as the other, has four times the mechanical force. If the speed of a fly-wheel be doubled, it has four times the power it had before."

At page 11 of the catechism I find that in practice when the power resident in the fly-wheel rim, at its average speed, is from 2½ to 4 times greater than the power generated in one half-stroke, the engine will work with sufficient regularity for most ordinary purposes, but where great regularity is required it will be advisable to make it six times." Now—suppose the piston to be a weight of 540lbs, moving 3·5ft per second, and fly-wheel 2·5ft mean dia., moving 21ft. per second, 6 times the speed of piston, I infer, according to Bourne, it will have 36 times the momentum; consequently piston=540lbs×3·5=1,990lbs. momentum.

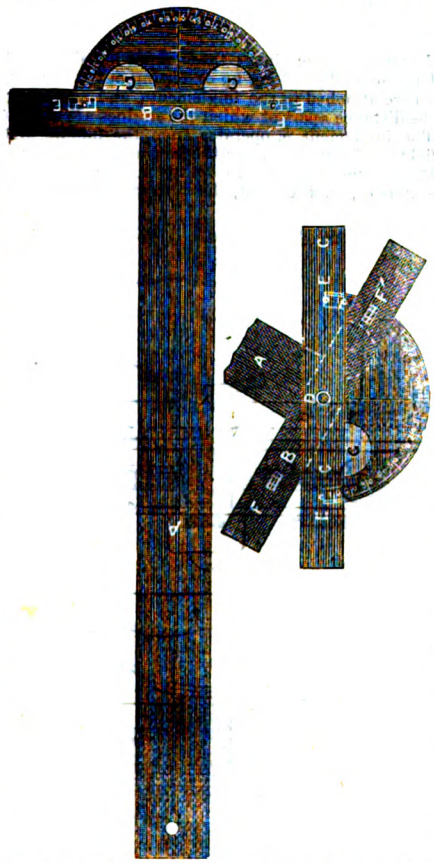
Fly-wheel moving 6 times the speed, which squared is 36; 1,990÷36=55.27lbs weight of rim to equal momentum of piston, which only requires multiplying for the ratio of power wanted.

If any of your readers will explain whether I am right or not, they will oblige

Thomas Winder.

PROTRACTING T-SQUARE.

Sir,—Enclosed is the sketch of a protracting T-square that I have found useful, and doubt not but that it may be found useful by many. If it be known (as I suppose it is not) it is not so well known as it should be. If it be new, you may give it to those who want it through your columns. A and B are the ordinary blades, and fixed stock. C is a stock moving as usual on the clamp screw pin D. Into the inner



face of this stock there is a semicircle of planetree (3¼ inches radius), indented, which is divided into degrees, and figured from 0 at E E', to 90°. There are spaces cut through the fixed stock at F, F'; these are sloped to the centre, and laid with planetree, on which lines are drawn for reading off the degrees on the semicircle. G, G, are spaces in the semicircle, cut out for the fingers. It is useful for laying down, or reading off angular lines, drawing polygons with any number of sides, shading at various angles in one or two directions.

Gamma (Glasgow).

OPTICIAN'S CEMENT.

Sir,—In answer to R. W. (Oct. 6), Canada balsam is the cement used by opticians for cementing lenses together.

Old Charlie.

[Gamma, in answering, says:—"A drop is put on one glass; the other glass is laid on top—both slightly heated, and pressed together. One uses gum-benzoin, dissolved."]

DANIEL'S BATTERY.

Sir,—I beg to thank those gentlemen who kindly answered my enquiry respecting Daniel's battery, and I have now reversed it, and have it in this form: six earthenware jars, and placed in each a cylinder zinc; amalgamated in the centre of each zinc is a porous tube which is half inch apart from the zinc; all round in each porous is a flat strip of copper connected to the next zinc. I have put water between the zinc and porous tube, and in the tube is a strong solution of sulphate of copper. I have had it thus two days, and as yet not any signs of electricity. Can any reader give me further information?

Alfred Crofts.

MISCELLANEOUS ELECTRICAL NOTES.

Sir,—To "H. Brown," No. 27.—Ladd, No 11 and 12, Beak-street, will probably give you all the information you require relating to electric sparks. You are not very explicit as to your exact requirements. If you merely wish for sparks at intervals, a few couples of Daniel's, joined in circuit with your condenser, or secondary batteries, will perhaps be sufficient. If you want a continuous spark ½ inch long, you will find it expensive, with batteries alone.

J. Round had better apply to the same agent.

A popular work on electricity would most likely answer Comus's requirements. Lardner's "Handbook" is just the thing.

T. B. R.—It is not exactly necessary to insulate the wires comprising the iron core of induction coils, but it is frequently done in some of the more expensive descriptions, in order to increase the rapidity of charge and discharge when in use.

Knobstick, No. 28, must refer to No. 21 for a description of method of electrotyping iron with copper. If he wishes to electrotype or electro-gild, the better plan would be perhaps to coat with copper first. Napier's "Electro-Metallurgy" is one of the best works on the subject.

J. Newton, No. 29, will find an answer respecting sparks from magneto machines in No. 27.

J. W. Merthyr can obtain carbon batteries and models of electro magnetic engines, either at Faulkner's, Foster-lane, or at Horne and Thornthwaite, Newgate-street. The prices of these instruments vary from £1 upwards.

I must remind J. D. E. that electro-magnets are not often used for giving shocks. A modification known as the induction coil is more frequently used for this purpose, and has been fully described by your correspondents in previous numbers. It may, however, be useful to some of your correspondents to know how the electro-magnet can be used for giving shocks; I will, therefore, give the information:—Wind the horse-shoe in the usual manner, with, say 1lb. of No. 35 copper-wire, placed over the poles and armature contact breaker, similar to those used for induction coils. Join one pole of a 6 or 12 cell Daniel, to one of the ends of electro magnet, connect the other end to one side of the contact breaker, and to the other side of breaker, join the 2nd pole of battery. To give shocks it is only necessary to connect a wire from either side of contact breaker to the person desirous to receive them.

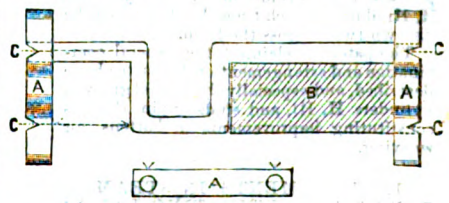
The strength of the shock may in some degree be regulated by attaching a spiral spring to the armature, so that the electro-magnet may have a greater resistance to overcome before attracting it; this has the effect of causing the armature to make and break with greater promptitude and rapidity.

Without going as far as Admirer in my appreciation of Mr. Tonkes' talents, I cannot help remarking that the knowledge displayed by this gentleman on electrical matters is highly creditable, especially if he has acquired it without the aid of books.

Edwin Furze.

CRANK TURNING.

Sir,—In reply to "Systematic," as to crank turning, turn each end of crank shaft to any given size, leaving a shoulder at the end of the cut or trued part. Bore a hole in one end of two pieces of rough cast or wrought iron, to fit, and



key-tight on each end of crank shaft; the pieces must be strong. Key the pieces A on in a line with the crank journals, and find the centres on the pieces opposite the required centre C of crank journal; B is a piece of wood used as a stay.

J. M.

AIR PUMP VALVES.

Sir,—In reply to J. Bacon, turn down the top of the piston (of brass) for a short distance say, three-sixteenths of an inch to about five-eighths of an inch diameter, and turn a small groove near the top, so as to make it something like the neck of an old-fashioned phial. Drill a hole through the centre about the tenth of an inch diameter, over which place a strip of bladder about three-eighths of an inch broad, and tie it on by a bit of silk in the groove. Construct the bottom valve in a similar manner.

Wm. Taylor.

A new material for paper making has just been discovered in France. With the root of lucernes M. Caminade has succeeded in making a pulp which can be employed jointly with rags in the manufacturing of paper, and even separately.

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IMPROVEMENTS IN THE CONSTRUCTION OF BATTENS FOR WEAVING.*

This invention of John Thomas Cook, of Leicester, consists in adapting to the shuttle races of looms employed for plain and figure weaving, and for the manufacture of elastic web, certain novel and improved mechanism for driving the shuttle.

Fig. 1 represents an elevation of the back of the batten and shuttle race of a loom suitable for weaving narrow goods, such as elastic web, showing the improvements adapted thereto. Fig. 2 is a plain view of the shuttle and batten, and portions of the shuttle race, showing the method of connecting the shuttle with the improved mechanism for throwing the shuttle across the loom, and through the shed of the work. Figs. 3 and 4 respectively exhibit transverse and vertical sections taken through the line A, B, and C, D, of Fig. 1.

COCKS WEAVING.

FIG. 1.

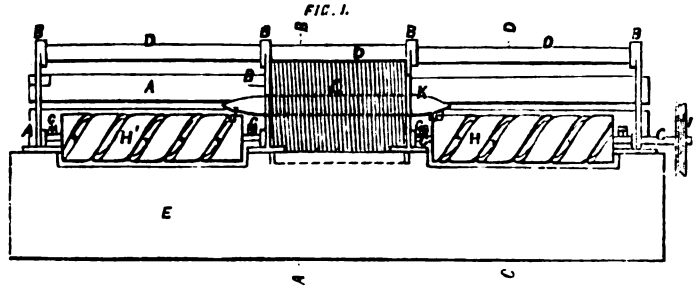


FIG. 4. FIG. 3.

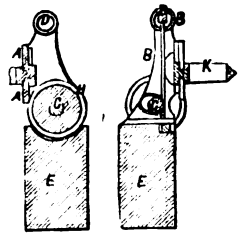
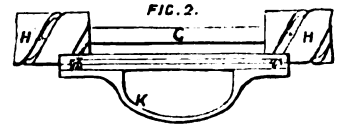


FIG. 2.



A, A, are boards forming, by the spaces at *a*, *a*, the shuttle race of the loom; B, B, are brackets for holding the boards A, in proper position; C is that part of the batten which beats up the work at each shed of the warps; the upper part of C takes into a slot formed in the tube D, and the lower part rests in a recess formed in the piece E, to which piece the brackets B are securely fixed. G is a long spindle supported by, and working in bearings formed in the brackets B; H, H1, are cylinders having helical grooves, or quick-threaded screws *, *, formed around them; these cylinders have a hole formed through the centre of each, in the direction of their length, so that when said cylinders are passed on the spindle G, and tightened thereon by the screws *c*, *c*, the aforesaid spindle and cylinders will revolve together upon rotatory motion being imparted thereto, either by an endless strap or band passed over the pulley I, or by other convenient and suitable means; K is the shuttle carrying the cop containing the weft in the usual way. For the purposes of this invention studs or pins *d*, *e*, are fixed into the back of the shuttle near each end thereof, and take into the grooved helices formed around the cylinders H, H1; care being taken to so arrange them with respect to the helical grooves in the cylinders H, H1, that when the shuttle is thrown across the loom, and through the shed of the work, in the act of weaving, one of the pins shall not leave its respective grooved cylinder until the other pin has entered into the helical groove of the other cylinder. In order to obtain great velocity of the shuttle, the grooved helices should be made of such a pitch that one revolution of the loom shall produce two revolutions of the cylinders H, H1, during which time the shuttle will be thrown twice across the loom.

The patentee claims "the general combination and arrangement of the parts above described, and especially the helical grooved cylinders H, H1, and studs or pins *d*, *e*, as constituting improvements in battens for weaving."

IMPROVEMENTS IN STEAM POWER IN CULTIVATING LAND.*

The invention of Henry Septimus Coleman and Alfred George Edwin Morton, both of Chelmsford, relates, first, to a novel application of two steam engines (one at each side of a field) in the traversing of two implements to and fro in tilling the land, such engines both operating simultaneously on the same circuit of rope or ropes by which the implements are propelled.

The invention relates, secondly, to a peculiar construction of drum or rigger for communicating the power from the engines to the traction ropes of agricultural implements, whereby endless ropes can be used, and at the same time a sufficient holding power is provided therein for the purpose required, the peculiar construction of drum permitting of the rope passing more than once round it.

Fig. 1 is a diagram showing the improvements in the application of steam power to the cultivation of land. *a*. *a*1, are the engines placed at the headlands. With the exception of the rope drum, they are of the usual construction, but may, of course, be each of less power than where only one engine is employed. *b*, *b*1, are the two implements; *c*, *c*1, are the ropes passing round the rope drums of both engines: these ropes are shortened or lengthened by taking up or letting out at the points where attached to the implements, and according to the distance apart at which the engines are disposed. The implement *b*, operates from the middle of the field to the engine *a*, on the left, and the implement *b*1, operates on the land from the middle point to the engine *a*1, on the right, the retrograde movement of the one implement taking place while the other is in work. The implement moving backwards does so in each case on the unbroken ground. The implement *b*, is represented as in work while implement *b*1, is moving backwards. Each of the implements *b*, and *b*1, is, of course, supported to represent a combination of ploughs, scarifiers, or other instruments combined in one frame, as is well understood.

By this arrangement it will be readily understood that, with both engines working simultaneously, the power of engine *a*, for instance, will be transmitted directly to *b*. (the implement in operation) by the rope, *c*, while the power of the engine *a*1, will be transmitted directly to *b*1. (the implement out of work) by the rope *c*1, but which will be in excess of what is required for producing the retrograde motion thereof; the surplus power will consequently be transmitted by the rope to the drum of the engine *a*, round which it passes, and thence to the implement *b*, in work, and therefore utilizing the whole power of both engines. The engines are moved forward on the headlands in the ordinary manner at such times as will cause the implements to be hauled in the directions necessary to traverse the implements in the lines desired.

COLMAN & MORTON'S HAULING APPTS

FIG. 2.

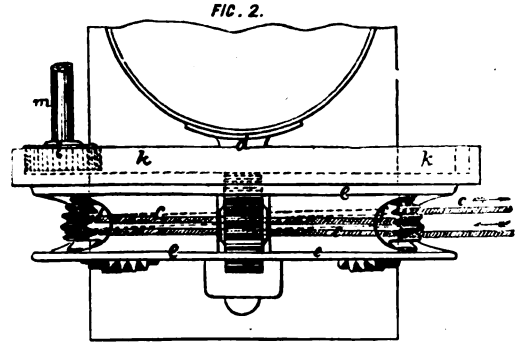


FIG. 3.

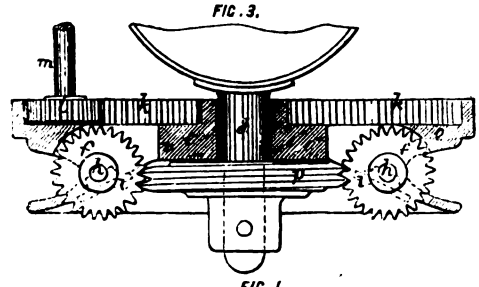


FIG. 1.

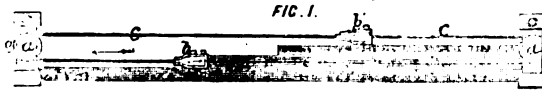


Fig. 2 represents a transverse section of part of an engine boiler, having a rope drum arranged and constructed according to this invention; and fig. 3 is a transverse vertical section of the drum. It is mounted on a strong stud *d*, fixed on the under part of the body of the boiler, somewhat as usual. *e*, is the drum cast with a broad groove or face, in which the pinions *f*, *f*, are disposed, as seen; they are mounted on axes *h*, *h*, received in bearings *i*, *i*, in the arms or body of the drum. The drum is cast with a flange and inner ring of teeth *k*, in which a pinion *l*, takes, receiving motion from the engine by means of the shaft *m*, on which it is mounted, as well understood. The V-grooves in the pinions *f*, form the grooves in which the rope *c*, shown by dots, encircling the drum, lies, by which it is kept in parallel coils. The teeth of the pinions *f*, take into a stationary screw thread *p*, fixed on the bottom of the stud *d*, which controls the position of the pinions, and which by the rotary motion of the drum imparts a slow rotary motion to the pinions *f*, on their axles *h*, the amount of such motion being equal to the distance from one tooth to another of the pinions *f*. Thus the required position of the rope on the drum is uniformly maintained throughout its action, and as indicated in dots in fig. 2.

The patentees claim, "First,—the combination described, in which the power of two engines is applied to two distinct agricultural implements, in the manner described. Second,—the combination, arrangement, and operation of parts represented and described, with reference to figs. 2 and 3, constituting a hauling rope drum, and its application for the transmission of power applied to agricultural implements.

* From Newton's *Journal of Arts*.

ASTRONOMY.

Photosphere of the Sun.—Mr. Fletcher was enabled to observe the disc of the sun to great advantage during this summer. Finding no spots of sufficient magnitude to arrest his attention, he turned the telescope on the surface of the sun itself, and with the help of Dawes' solar eyepiece, armed with a power of 410 and an aperture of a quarter of an inch, saw all the features admirably. He found the entire surface, on each day when it was examined, covered with minute white granules, and although the "rice-grain" comparisons of Mr. Stone are very felicitous, yet the shapes were too various to be accurately described by any general term. They have sometimes been kept in view for a space of from ten to fifteen minutes without any change in situation or form being perceptible. None of that peculiar appearance of interlacing could be detected, unless when the air was tremulous. Mr. Fletcher is of opinion that the granules are not "entities" at all, but only some portions of the sun's luminous atmosphere delevate into the outer or non-luminous atmosphere. They were estimated to beabout two or three seconds in length, and about a third of that quantity in breadth, but no general form could be distinguished, and there was no tendency to elongated forms. If such were the shapes observed, he concludes that no interlacing could be perceived unless the granules were dies of extreme thinness; but no such structure could be imagined. Mr.

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Fletcher thinks that those phenomena were well known to Sir W. Herschel, and that they are fully described by him in the "Philosophical Transactions" of 1801. The drawings which accompany that paper seem to confirm that opinion.

SWEDENBORG.—No. I.*

Sir,—I am glad to find that one influential journal at least is courageous enough to give admission to a biography of a man misunderstood by the age in which he lived, and whose merits are only beginning to be recognised: and also for the opportunity given me to set before your thousands of readers what little it is in my power to give respecting the life and works of one who was most emphatically the "friend of the people." But I would have the reader understand that I do not profess to render an essay warranted to come scatheless from the critics—the necessities of a business in which close application is a primary necessity prevent my paying attention to the requirements of the Academy. I would, however, express the hope that what I have collated and am about to exhibit may not cause your inquiring correspondents to regret the expression of their curiosity; and should the result of their perusal of these necessarily brief papers be the creation of an interest in their subject, I shall be amply repaid for whatever of time and labour has been expended thereon. E. C.

At Stockholm, on the 29th of January, 1688, the wife of the Bishop of Skara, Westrogothia, gave birth to Emanuel Swedberg—named Swedenborg, when, in 1719, he was elevated to the rank of nobility. It should be stated, however, that at the time of this addition to his family, Swedenborg's father was only chaplain to a cavalry regiment of the Guard, also, that he was a great patriot—exhibiting his patriotism in an eminent degree at a time when Sweden had lost her veteran armies, and "was fain to send her lads and old men into the field against the combined forces of Russia, Poland, and Denmark—while she was afflicted within by famine and pestilence." Young Swedenborg received the best classical education which the time afforded, and in 1709 took his degree of Doctor in Philosophy at the University of Upsala. In 1710 he took ship for London, where, and at Oxford, he spent a year, at the end of that time crossing over to Holland, thence journeying into France he stayed a year at Paris and Versailles, returning home in 1714. On his return he still busied himself with mathematics and mechanics, and his attainments in these sciences soon procured him an acquaintance, and an intimate connection during many years, with the Archimedes of Sweden, Christopher Polhammar, probably best known to our times as Polheim. By this connection he not only acquired great attainments in the science of mechanics, but obtained the further advantage of partaking of the confidence with which Polhammar was honoured by the celebrated Charles XII. The diploma appointing him to his office of Assessor Extraordinary of Mines in 1760, states that the King had a particular regard to the knowledge possessed by Swedenborg in the science of mechanics, and that his pleasure was that he should accompany and assist Polhammar in constructing his various mechanical works. His Majesty often made use of the knowledge and talents of the two geniuses, which in both of them, especially on the subject of mechanics, were accompanied with the gift of the most happy invention. This is not the place to speak of the works of Polhammar, otherwise there might be mentioned the famous dyke of Lyckeby, the locks of Trolhatta, the basin of Carlscrona, and other works. Of such, Swedenborg executed one of the greatest importance, during the siege of Frederickshall, in 1718. He contrived to transport over valleys and mountains, by the help of rolling machines of his own invention, two galleys, five large boats, and a sloop, from Stromstadt to Iderfjol, which divides Sweden from Norway towards the South—that is to say, for a distance of 14 miles. By this operation, says M. Sandel in his "Oration," the King found himself in a situation to carry on his plans, for, under cover of these galleys and boats, he transported upon pontoons his heavy artillery, under the very walls of Frederickshall. In the same year he published an introduction to Algebra, which was honourably reviewed in the "Literary Transactions of Sweden," for its excellence, clearness, and practicability. It is comprised in ten books, and treats on—1. The explanation of the terms employed, and the simple arithmetical processes. 2. The mechanical powers—lever, pulley, inclined plane, &c., with a variety of problems. 3. Laws of proportions, also with numerous problems. 4. Geometrical theorems, stereometry, and specific gravity. 5 and 6. The properties of the parabola and hyperbola, with numerous other problems. 7. Theory of projectiles and artillery, with problems. 8, 9, 10. On adfected roots, and the integral and differential calculus. This profound work was followed by his "New method of Finding the Longitude of places by Lunar Observations." At this time it is interesting to note our author's complaint that his labours are not appreciated, that his productions "are looked down upon by a number of political blockheads as mere scholastic exercises, which ought to stand back, while their presumptuous finesse and intrigues step forward." It is only just to our author to here note that previous to this he had ventured, and with success, to publish as a poet. Much of his product has the true ring about it, though I am not aware whether it has all been done into English. In 1719, as noticed, the family of Swedenborg was ennobled by Queen Ulrica Eleanora, and our author took his seat with the nobles of the Equestrian Order, in the Triennial Assemblies of the

SWEDENBORG.

States. In the same year he published four works, the first on a proposal for fixing the value of coins, and determining the measures of Sweden, so as to suppress fractions and facilitate computation; after which he was commanded by his sovereign to draw up a mode of computing by eighths, which he completed in a few days with its application to the received divisions of coins, weights, and measures: also a disquisition on cubes and squares, and a new and easy way of extracting roots—all illustrated. The honour of introducing the differential calculus into Sweden is due to our author, as that of the decimal mode of numeration (founded on ciphers up to 64) is due to his sovereign. The second work of the four above-mentioned is a treatise on the motion and position of the earth and the planets; the third on arguments derived from the various appearances in the North of Europe, in favour of the depth of the waters and greater tides of the sea in the ancient world. The fourth is an interesting and clear little work on docks, sluices, and salt works, to which I may allude hereafter.

About this time our author contributed papers to the *Acta Literaria Suecia*, and in 1721 undertook a professional journey to the mines and smelting works of Saxony and the Hartz mountains. Besides accomplishing the principal object of his journey—though it lasted but fifteen months—Swedenborg published several important works at Leipzig and Amsterdam—among them "A Geometrical Explanation of Chemistry and Physics," treatises "On Iron and Fire," and "Miscellaneous Observations" on subjects connected with the physical sciences, especially on minerals and the strata of mountains. At this period, according to C. E. Strutt, in his introduction to his translation of our author's "Prodromus Principiorum Rerum Naturalium"—or forerunner of a new chemical philosophy—chemistry was in a state of transition: the science possessed no uniform and definite nomenclature, as no comprehensive theory had yet arisen; and the doctrine of the Four Elements held "divided empire" with that of the Three Principles of the alchemist. Forth came Swedenborg, with a clear perception of the desiderata, with his new chemical philosophy, which he founded partly on the ideas of the ancients, concerning ultimate atoms. A characteristic of his system is the explanation it gives of the origin of saline atoms—constituting the first inert matter—in the depths of the primeval ocean, where they are presumed to have been moulded in certain interstitial spaces, vacated by the etherial element, between the bullular particles of water. The theory treating all substances in the domain of physics and chemistry as subject to a peculiar mechanism, *variety* is referred to difference of position, weight, and motion. Says Mr. E. Rich ("Sketch," p. 13):—This extraordinary attempt to bring invisible things to light has been thoroughly justified by the success which has attended Dalton's hypothesis in an age better prepared for its application; and by the equally remarkable fact that the definitions given of salts, acids, and alkalies, have gradually approximated very near indeed to those which result from Swedenborg's hypothesis. We say nothing here of a latent connection between the principle on which it is founded, and some of the results obtained by Berzelius, "whose fame, as a chemist, is as wide as the civilized world."

(*To be continued.*)

* We desire it to be understood that we do not necessarily endorse all put forward by the writer: advocates for fair play, we willingly give room to a fair notice of the life of a man thought by many to have been most grossly maligned by his contemporaries and the present generation.—Ed. E. M.

GENERAL NOTES.

Manufacture of Iron and Steel.—The object of the invention patented by Mr. S. C. Kreeft, of Fenchurch-street, for Mr. Jacopo Bozza, of Naples, is to impart homogeneity, and a compact molecular arrangement, to cast-iron, cast-steel, and Bessemer metal, and thereby give increased strength to the articles manufactured therefrom. To this end a current of electricity is applied to such metal while in a state of fusion, obtained either by means of a voltaic battery or by an induction apparatus. The electric current is applied during the running off of the molten metal, and is thereby caused to assume, while in a state of fluidity, the desired homogeneous and compact molecular arrangement which is retained after cooling. The metal thus treated acquires a tenacity very superior to that of metals manufactured in the ordinary manner. The effect of this treatment is also to give to the metals a perfect magnetisation, which renders possible the economical construction of magnets and other applications.

Clocks and Watches.—There has been a great falling off in the number of clocks imported this year. Thus the total imported to August 31 was 149,916, as compared with 212,315 im 1864, and 196,087 in 1863 (corresponding periods). The number of watches received from abroad in the first eight months of this year was 96,401, against 87,282 in 1864, and 100,937 in 1863 (corresponding periods). The number of clocks imported will be seen, however, notwithstanding the reduction observable this year, to be still very large, and, considering that the home clock manufacture is not inactive, it is difficult to imagine what becomes of all the results of the foreign horological efforts which we press into our service.

Explosive Power of Powder.—The result of some experiments with explosive materials which are on record are almost incredible. Rumford having charged a mortar with one-twentieth of an ounce of powder, and closed every orifice with great care, placed above it a mass of metal which weighed more than 8,000lb. The result of explosion was the bursting of the mortar and the lifting of the enormous weight. In another experiment, a piece of iron which would have required a strain of 400,000lbs., was torn asunder through the explosion of 28 grains very closely confined in a cylindrical space. Facts such as these cannot fail to point to the terribly destructive power of the torpedo, if the maximum of explosive force, combined with the minimum of charge in a given space, be once fairly ascertained and tested by practical experiment. The opinion of many authorities against a gigantic system of coast fortification, points to the necessity for some cheap and efficient means of defence for our unprotected roadsteads and harbours.—*Scotsman.*

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WAKEFIELD INDUSTRIAL AND FINE ARTS EXHIBITION.—The exhibition was finally closed to the public on Saturday, on which day the number of persons admitted was 7,232. On Monday the school children were admitted, and the building presented a very cheerful and animated appearance. On Thursday the closing ceremony will take place.—*Leeds Mercury.*

TINWARE.—A ministerial order has been issued in France that only utensils tinned with pure tin should be used in the military hospitals, and M. Jeannel gives the following process for detecting small quantities of lead in tin. He treats five decigrammes of the metal filed off with an excess of nitric acid diluted with three times its weight of water, boils the mixture, filters, and then drops into the solution a crystal of iodide of potassium. If only one ten-thousandth of lead is present, a yellow precipitate is formed, which does not disappear on adding an excess of ammonia.

TO BLACKEN ZINC STATUES, &c.—Make a solution of six parts chloride of antimony in one part of alcohol and four parts hydrochloric acid, and apply it to the object with a brush. Wipe the figure over with a wet cloth, and then apply the solution a second time. Now dry the object as quickly as possible in a warm place. When it is perfectly dry rub it all over with oil.—*Deutch. Illust. Gewerbztg*, 1864.

STEEL FOR SHIPBUILDING.—A vessel which has just arrived at Liverpool is said to afford a remarkable instance of the value of steel as a material for ship-building. This vessel rode out the cyclone at Calcutta last year. She was run into twenty times, and her plates twisted in every direction, but not one was cracked.

A GIGANTIC steam road locomotive, which was brought to Belfast from Fleetwood to work in connection with the quarries at Newcastle, county Down, was driven through Belfast last week, and attracted large crowds of spectators. The works are massive and elaborate, and the machine is calculated to carry 80 tons with ease.

WE learn that the German astronomers have agreed to give the name of Clio, the muse of history, to M. Luther's new planet, the eighty-fourth of the series, discovered on the 27th of August last. It has been observed at Bilk, Cracow, Berlin, and other places, so that its orbit will soon be calculated. We also learn that M. Goldschmidt has rediscovered the planet Diana.

THE English mix chlorate of potash, the French nitrate of potash with the fulminating mercury used for filling percussion caps. The English are less liable to corrosion than the French.

THE quantities of tin, copper, and lead ores produced in Great Britain last year were 15,211 tons, 214,604 tons, and 94,433 tons respectively. From the lead 641,088 ounces of silver were obtained.

Mr. HUGGINS states that from spectrum observation he has made he is led to believe that the stars closely resemble the sun, and that the source of their light is probably solid matter in a highly incandescent state.

ARSENIC has been proved to be almost invariably present in the ochreous deposit thrown down by water. Professor Otto readily discovered its presence in the crust which had formed on the inside of his tea-kettle.

PROFESSOR WEDL found, on examining some sections of teeth that had been macerated for a few days in water, that they were attached by fungous cells resembling mushroom spores. They perforate the ivory, but not the enamel.

Dr. FRANKLAND ascertained that one gallon of mineral oil was equal in illuminating power to 18lb. of paraffin candles, 22lb. of sperm, 26lb. of wax, 27lb. of stearine, 29lb. of composite, or 39lb. of ordinary tallow candles.

Mr. DAWES has discovered certain features in the planet Mars, which, from their appearance, he describes as a long narrow strait running N.E. and S.W. with two wide mouths of rivers, which he, however, could never trace.

Dr. SJOGREEN, a Swedish naturalist, states that the particles of pure iron found in the Swedish lakes result from the deoxydizing action of certain insects. Their larvæ absorb oxygen from the oxide of iron and form a cocoon of pure metal.

BY order of the King of Sweden, experiments with submarine infernal machines are about to be tried on the old ship of the line "Charles XIII."

THE finance of the late East London Working Classes Industrial Exhibition turns out satisfactory. The expenditure was £377 4s. 7d., the income £377 14s. 5d.

ELECTRICITY.

NOVEL EXPERIMENT.—It is undoubtedly a matter of considerable importance in many harbours that it should be known with certainty by those about to enter or leave, when there is a sufficient depth of water for the purpose. M. Emile Duchemin has devised a very simple application of electricity, which answers admirably for this purpose. He attaches to a small float a plate of carbon and a plate of zinc, and connects these respectively with the wires of an electric bell-ringing apparatus. Throwing the float and battery into the sea will cause the bell to ring. When therefore they are suspended at any required height, within reach of the tide, as soon as the water has risen sufficiently to set the small battery in action, the bell will ring; and thus the apparatus may, at pleasure, be made to indicate any state of the tide. By using a sufficiently large float and battery, it is evident that an electric current will be generated sufficient to sound a bell of considerable size, or, by means of Geissler's tube, to produce a light which will be seen from a great distance.

PROFESSOR WHEATSTONE ascertained that the duration of the electric spark does not exceed the twenty-five thousandth part of a second. A cannon ball would appear stationary in its flight if illuminated by the spark, and the wings of an insect that move ten thousand times a second would seem at rest.

CHEMISTRY.

TEST FOR OTTO OF ROSES.—Hager mixes five drops of the otto to be tested with twenty drops of pure concentrated sulphuric acid. Whether the oil be adulterated or not, a thick yellowish brown or reddish brown mixture results. When this mixture is cold, it is shaken up with three drachms of absolute alcohol. If now the otto is pure, a tolerably clear yellowish brown solution results, which, after heating to boiling, remains clear. But if the otto is adulterated with geranium, palm rose, or pelargonium oil, the solution remains very cloudy, and in some cases a darker fluid separates, in which a deposit forms. On heating this solution, the sediment melts together, and from the size of the mass the author infers the degree of adulteration. If, for example, the mass has one-fourth the volume of a drop, he concludes that the otto was mixed with at least one-third of foreign oil. If the otto is adulterated with spermaceti, this substance separates and floats on the surface of the solution, or remains suspended in the liquid as a scaly crystalline mass. The above test is founded on the circumstance that pure otto of rose forms, with strong sulphuric acid, a resinous substance, which is completely soluble in absolute alcohol; while the substance formed with other oils is only partially soluble. Guibourt has observed that the odour of pure otto is not affected by mixure with strong sulphuric acid, but if other oils are present a disagreeable odour is developed.—*Zeitscht, fur Analyt. Chem.*, No. 4, 1864, p. 479.

SCHULTZE'S WHITE GUNPOWDER.—This is trinitrocellulose, prepared from saw-dust by the following process. The saw-dust is first boiled for three or four hours with a weak soda solution, and then boiled a second time with a fresh lot of the same solution. It is then washed in running water, afterwards steamed for fifteen minutes, and then again washed in running water for twenty-four hours. It is now bleached with chlorine or chloride of lime, boiled in water, once more washed in a stream, and now dried. The saw-dust is now ready to be treated with nitric acid. For this purpose a mixture of 40 parts strong nitric acid (1·48 to 1·50) are mixed with 100 parts of sulphuric acid (1·84); and the mixture is allowed to stand two hours to cool. One hundred parts of this mixture are then placed in an iron vessel, around which a stream of cold water circulates, and six parts of the saw-dust are gradually added, stirring all the time. The saw-dust is allowed to remain in the acid two or three hours, the stirring being continued. After this time the whole is transferred to a centrifugal machine, and the acid separated. The wood is then washed for two or three days in cold water, afterwards boiled in a weak soda solution, again well washed in cold water, and then dried. It is now ready for the final operation, which consists in soaking it for ten or fifteen minutes in a solution of 26 parts of nitrate of potash in 220 parts of water. After this, it is carefully dried at a temperature not exceeding 44° C.; the very fine dust is then separated by means of a drum sieve, and the remainder is ready for market. *Chem. Central Blatt*, No. 44, p. 704.

THE MANUFACTURE OF PYROGALLIC ACID.—A very valuable process has been discovered in France, whereby the pyrogallic acid, so largely consumed by photographers, can be made in much larger quantities and cheaper rates than hitherto. By means of the old process 100 parts of gallic acid yielded but 25 or 30 per cent of pyrogallic acid. By the process just been made known to the Academy of Sciences at Paris, by M. de Luynes, 100 parts of gallic acid are made to yield 60 parts of pyrogallic acid. The new process is a somewhat complicated one, and the pyrogallic acid is first formed in solution instead of in its usual state.

M. D. GERNEZ states that he distilled some water in a platinum alembic twice, and then caused it to be traversed slowly by air drawn by aspiration in the middle of the park at Talmay, at a great distance from any habitation. Some drops of the water, when submitted to evaporation on a slip of glass, left behind microscopical crystals resembling those of sulphate of soda, and others upon which M. Gernez could not pronounce.

NOTES ON PHOTOGRAPHY.

UNEQUAL INTENSITY IN NEGATIVES BY THE NEW DEVELOPER.—Our esteemed correspondent, Mr. Burgess, of Norwich, says *The Photographic News*, writes as follows:—"I have frequently found, since using the gelatino-iron developer, that on varnishing the negative, some parts remained more intense than others (generally little patches on the background), apparently arising from the varnish not having penetrated at those parts. A second application of the varnish always causes these more intense patches of varnish, and a prolonged washing before drying avoids them altogether." Perhaps this will be of service to G. U. N., and any others who may have met with a similar effect.

MAGNESIUM LIGHT FOR COPYING PAINTINGS.—We understand that Mr. Thurston Thompson has recently photographed Maclise's "Death of Nelson," recently finished in the Royal Gallery at Westminster. The light was supplied by burning magnesium, the lamps used being those of Mr. Solomon.

PHOTOGRAPHS OF THE ECLIPSE OF THE MOON.—At a recent meeting of the Photographic Section of the Literary and Philosophical Society, Mr. A. Brothers submitted a valuable series of instantaneous photographic negatives, taken by him during the progress of the late eclipse of the moon. The total number of negatives is twenty, of which sixteen represent the progress of the eclipse. An attempt was made, by the exposure of a one-plate for fifteen seconds, to obtain the darkened limb of the moon, but no photographic action resulted. In mentioning the name of Mr. Brothers we are reminded that his name is mentioned in the report of the photographic jurors at Dublin, in connection with some complimentary remark on his photographs by the magnesium light, as "Messrs. Brothers," instead of Mr. A. Brothers.

PHOTOGRAPHS OF THE CHINESE GIANT.—The London Stereoscopic Company have just issued a series of capital photographs of the famous Chinese giant *Chang*. Some in which the wife of the giant is portrayed by his side give a more striking illustration of his immense proportions than could be effected by any other method; others with the dwarf by his side gives a ludicrous effect to the pigmy stature of the latter. We understand that it is the intention of the Company to have one of the portraits enlarged to life-size, 7 feet 8 inches, thus obtaining the largest photograph which has probably ever been produced. The excellence of the card pictures afford facility for a very fine enlargement.

ORIGIN OF PHOTOGRAPHY.—In connection with this subject, to which we have referred once or twice lately, we may mention a piece of collateral evidence which recently came under our attention, which strongly aids in establishing the claims of the Rev. J. B. Reade to the use of gallo-nitrate of silver some years before it was patented by Mr. Talbot. Mr. Reade told us that one of his early photographs, produced in the solar microscope on the paper prepared with chloride of silver and washed with an infusion of nut-galls, was an enlarged copy of a flea, which he gave at the time to Mr. Akerman. Mentioning this circumstance to Dr. Diamond, he told us that the same photograph was given by Mr. Akerman to him the Sunday on which King William IV. died, the circumstance being impressed on his mind by hearing, shortly after receiving the picture, the bell of St. Paul's toll, and the exclamation being made that some member of the royal family must be dead. This, it will be remembered, was in June, 1837. The photograph in question, Dr. Diamond states, had all the peculiarity of the early developed prints.—*Photographic News.*

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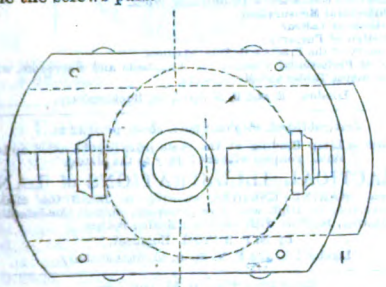
OVAL CHUCK, &c.

Sir,—Herewith I send, according to promise, drawings of oval chuck, to which I append others of a simple eccentric chuck, which any amateur can fit up for himself. Letters have not been placed on the various portions, but the following explanation, it is hoped, will prove quite intelligible. An oval (ellipse) is produced in this chuck upon the principle of adding two crescents to a circle, one to each side. As the object approaches the cutting tool, it is gradually thrust forward by an eccentrised ring acting on a sliding plate in the chuck, and then gradually withdrawn; this takes place twice during each revolution, and an oval is the result. Figure 4 is a top-view shewing the chuck, its projecting nose similar to that of the mandrel, the jaws to embrace the ring, the ring in front of the face of the headstock, the screws to secure it there, and the bent plate or staple passing to the rear of the right hand upright of the head stock, through which staple the screws pass.



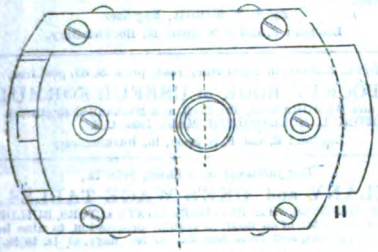
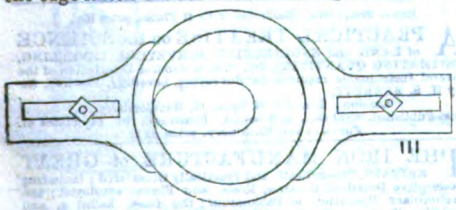
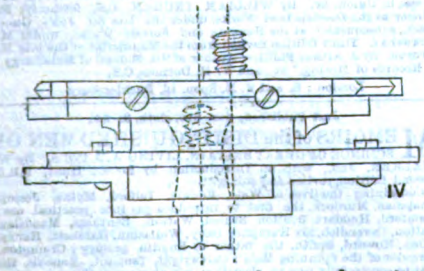


Fig 1 gives back view of chuck, the sliding portion of which projects to the right. The centre boss is that into which the mandrel-nose is screwed, and on each side are the projecting jaws which are fastened to the sliding plate. The dotted circle marks the position of the ring, see fig. 3, and the four small circles are the tail-ends of four screws which fasten two slider plates at the front of the back-plate of the chuck. Fig 2 is the chuck viewed in front, the centre boss is the nose of chuck, the two screws in a line with this are those which secure the jaws for the ring; the other four screws near the edge fasten the two fillets to back plate. These

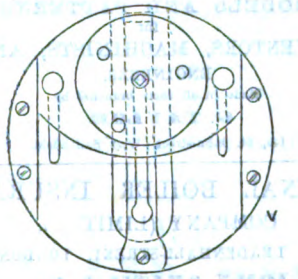


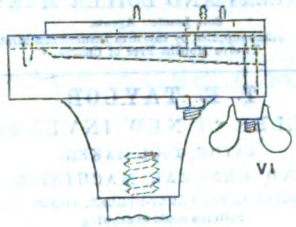


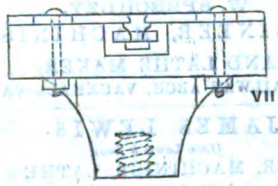
fillets have V-shaped grooves in one edge, along which the slider moves; they are somewhat thicker than the slider, so that the latter does not rub on the back-plate; each one has also the heads of two screws, working in edge of back-plate, pressing against it, to make up for wear in the slider and fillets.

The two jaws to the ring have also set pins in them, the holes for which, in the slider, are placed half a diameter nearer the middle than their true position would be, and the pin is filed one-half away to allow them to enter. Inserting a pin with less of its substance filed away and easing the screw-hole in slider, will make the jaws fit close to the ring as it wears. The two plates and staple can be of cast iron, the fillets and ring of gun metal, the jaws of case-hardened iron or steel. The usual lathe chucks fit on the nose of the slider, a flat piece of well-seasoned plane with a piece of box wood inserted at the centre in which the female thread is chased, forms a very useful one for picture frames.

The eccentric chuck (inventor unknown) is drawn in figures 5, 6, 7. The first of these is a front view shewing (1), two slips of brass between which an oval piece (2), slides; a circular piece (3) edged by 2, to which the block for chucking is secured by three screws entered at the back. The slips 1 are fastened to the lignumvitæ or box body by two wood screws each. The oval piece, 2, whose ends are cut off square, has a hole in it large enough to fit 3, and is secured by a screw-bolt at each end. These screw-bolts move in slots cut through the chuck, and so allow the centre of 3 to be placed eccentrically to the axis of the mandrel. The edges







of 1 are graduated for counting this eccentricity. A common division is into 1-120th of an inch. The circular plate 3 has rivetted into it an axis passing through a tongue, which is so fastened that turning the winged nut pulls it down in its recess, and makes 3 firm on its seat. The tongue is screwed loosely in position at one end, and has the bolt for winged nut at the other; it has through it a slot, one end of which is enlarged to admit the head of the axis of 3, the central part of which can glide along the slot. Round the circular hole in 2 are marked divisions, 96, 100, 144, or 192, to serve as a click or counting-plate. Some kind of slide rest or tool holder is requisite, or the rings in one circle of ornamentation will not correspond. Fig 6 is a side view with the tongue dotted out, and the chucking screws projecting upwards. Fig 7 is a section across the tongue-recess. The portions 1, 2, 3, are of brass, the tongue, axis, and bolts of steel. All the figures are about one-fifth of the real size. H. Hurst.

At the last meeting of the Literary and Philosophical Society, Mr. Dyer, referring to the breaking of the Atlantic Cable, expressed his surprise that no apparatus had been provided to seize and secure the end of the cable when the rupture took place, as contrivances for a similar purpose were in use in almost every cotton mill.

Sounds are distinct at twice the distance on water than they are on land.

MACHINERY AT THE DUBLIN EXHIBITION.

We have not yet had space in which to notice the very excellent "prize" turret clock by Booth and Son, Dublin. The principal feature in it is the "train remontoire" motion—designed to obviate disturbances originated in the exposure of large hands to the force of the wind, &c.: in other words, it cuts off from the escapement all the excess of power which of necessity is requisite for overcoming the retardive forces operating on the hands. This arrangement, then, consists of a spring, similar to that in a musical box, attached at one end to a carrier so designed as to rotate, and at the same time to be stopped at any given position. The other end of the spring is attached to the axis of the escape wheel. The spring, which is set up by the carrier, is released every thirty seconds with the requisite tension, propels the wheel, and, by the pallets, gives the force requisite to keep the pendulum swinging once it has been set in motion. Varying friction is thus disconnected from the pendulum, and great uniformity in its vibrations follows. The small force necessary to drive a pendulum is shown here. The pendulum is 14½ feet long from its hanging point, and weighs 3 cwt.; the impelling force acting on the pitch line of the scape wheel (4in. in diameter), is only 1½oz. This clock has kept time in the building since May, and gains but 7-10ths of a second per week. Its hands are driven by an independent shaft, upon which a pinion is mounted—its diameter being one-third of the main wheel with which it is in gear, and is fitted so that the shaft can turn within it, and so allows of the clock being set without disturbing the remainder of the works. Discharging, locking, and counting is effected by one lever, in place of the many complications usually employed to attain the same end.

Messrs. Courtney, Stephens, and Co., Dublin, exhibited a punching machine with shears combined—driven by a small engine attached to the frame of the machine, which works smoothly, and punches holes up to 1¼in. diameter, and through plates up to 1⅜in., with seeming ease. A simple and somewhat peculiar arrangement is exhibited whereby the operative can prevent the punch from working, while the machine is in motion, until the plate is set perfectly accurate. This is effected by a wedge-shaped piece of iron placed in justaposition with the man's hand, and, by its aid, half a second suffices to throw the punch out of gear. It will be evident that, with this at his hand, the workman can drive his machine at a quicker rate than formerly. The same firm exhibit a spur wheel just as it was taken out of the sand, without being operated upon by hammer, chisel, or file—as a specimen of good casting for accuracy of make and appearance of metal. It is moulded by a peculiar process, without a model; and the firm use this process for moulding all the gearing.

A handsome model of a compound governor is exhibited by the Messrs. G. and J. Weir, of Glasgow, which seems very sensitive in its working; and Mr. J. Byrne, of Dublin, shows one of his patent adjustable governors. This latter has four pendulums, but the number may be varied—the principle of construction being that the centrifugal force of the revolving pendulums is equilibrated at any required speed by the force of gravity of an adjustable counterweight or the tension of a spring. As to the number of pendulums it is considered to have Mr. Byrne's governor constructed with four, each with a crank springing from the joint at right angles, which are connected by means of rods to a sliding cylinder, having a steel centre let in at top. By this means the divergence of the pendulums raises the sliding cylinder, which, acting on the steel centre, gives motion to the valve; and when the engine at work receives a check through work being suddenly put on, the pendulums lose some of their sustaining power, of which the counterweight takes advantage by depressing them, and so admitting a greater supply of steam, which checks the error; or when work is taken off and speed increased, or steam pressure is increased, the pendulums acquire more centrifugal force, increase the angle of divergence, raise the counterweight, close the valves, and so reduce the supply of steam until the speed is checked.

Messrs. Courtney, of Dublin, exhibit pumps of different descriptions, one on the slide-valve principle showing considerable ingenuity, and somewhat resembling the engine which drives it. It is double-acting, and raises a gallon of water each revolution, the proper speed to drive being about 100 revolutions. It is now largely used on railways for supplying locomotives. But, respecting nearly all the Irish exhibitions it may be said that their display is extremely creditable.

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SCIENTIFIC AND MECHANICAL INVENTIONS.

Improvement in Air Tubing.—A valuable improvement in the manufacture of flexible air tubing has recently been adopted by Mr. Ellis Lever, the original inventor. In place of bevelled or flat iron hoops he substitutes a series of rings of round iron or steel, for the purpose of keeping the tubes open. These rings, instead of being welded, are so united that when pressed they yield, and can be reduced to one-third the original size; but immediately they are released become a perfect circle of the exact size of the tube. The tubing so made is said to be lighter, stronger, and less costly than the old kind.

The New Metal Indium.—This new metal, discovered by M. Schroetter by spectrum analysis, has a striking resemblance to cadmium. It takes its name from the beautiful line of indigo blue colour which it gives, which corresponds with number 2523 on the Kirchhoff scale, and does not coincide with any black ray of the solar spectrum. To determine its equivalent M. Schroetter serves the sulphuret with an aqueous solution of chlorine, which separates it completely from the sulphur, and the chloride of indium is formed. There is not the slightest trace of indium in the solar atmosphere.

M. Arman, the famous shipbuilder, has submitted to the Emperor Napoleon a new cable of his invention. The principal quality of this cable is its extraordinary lightness, so that there is little danger of its breaking under its own weight.

A new invention has been brought out, called the lock-jaw cotton gin. The effect is obtained by an intermittent nipping action, and it is said will turn out work more rapidly and of better quality, there being no breakage, rubbing, or felting together of the fibres.

Copying one Picture by many negatives.—Messrs. Cundall and Downes, in a recent copy of Herbert's "Descent of Moses from Sinai," obtained the picture by no less than twenty-one negatives, the prints from which are joined with great success, so as to form one harmonious picture.

The New Developer.—Mr. Cherrill suggests that the indication of the presence of free sulphuric acid in the new gelatino-iron developer will be imperfect development and the production of black spots in the negative.

A concentratd solution of chloride of zinc, which has been boiled with an excess of the oxide of that metal until it does not discolour litmus, will dissolve silk. By means of the dialyser the silk can be separated from its solvent in the form of a colourless inodorus solution.

Ehrenberg calculates 41 millions of individuals, infusoria, &c., in a cubic inch of tripoli.

An ordinary windmill has the power of about thirty four men, or, at most seven horses.

The Prussian Government is said to draw an annual revenue of 17,000 dollars from amber.

Herschell thought that the sun's luminous atmosphere is 2,500 miles from its surface.

DUBLIN

INTERNATIONAL EXHIBITION.

No. 632—Class D—Section 22.

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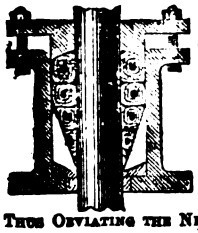

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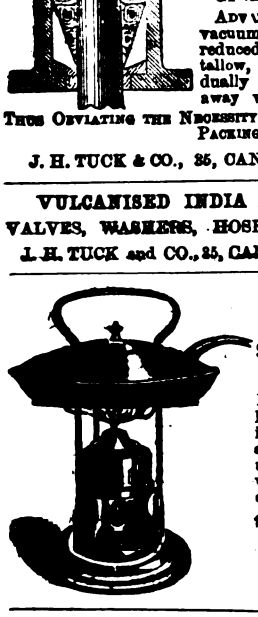

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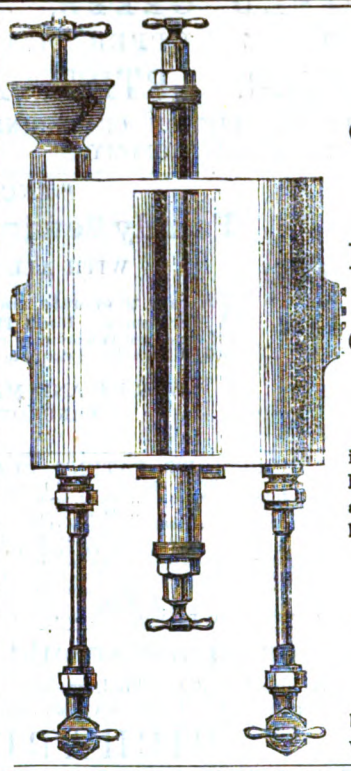

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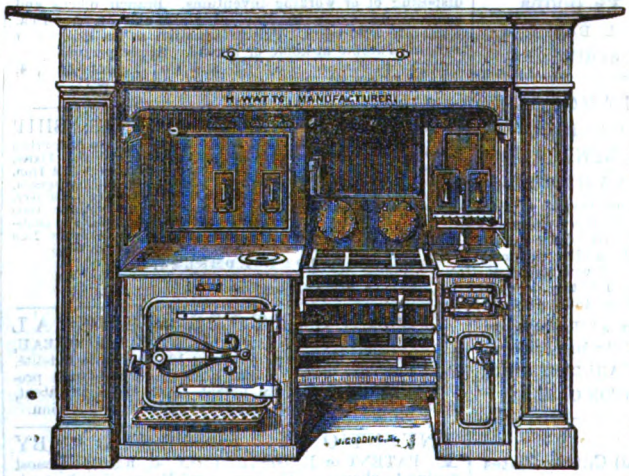

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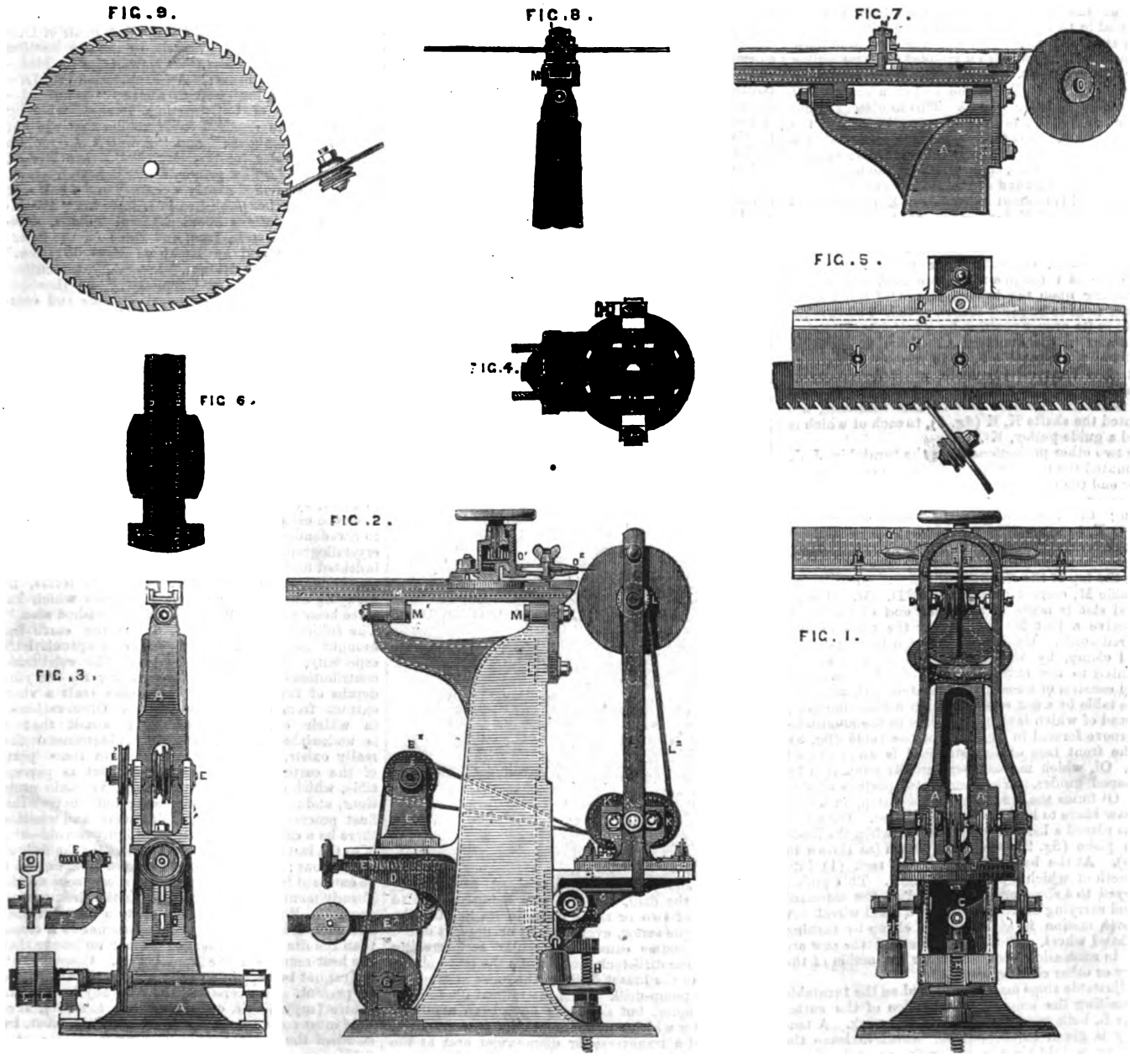

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thus enables the cutter to make a square or a chamfer cut as desired.

Fig. 1 is a front elevation of the improved saw-sharpening machine; fig. 2, a side elevation, partly in section; fig. 3 is a back elevation, showing the standard table and driving gear; fig. 4 is a partial sectional plan, showing the turntable which carries the cutter frame; and fig. 5 is a plan view of the clamp for holding a blade or web saw, and presenting it to the emery wheel, and fig. 6 is a partial plan view of the table detached; fig. 7 shows, in side elevation, the table fitted with a clamp for holding a circular saw, and presenting it to the action of the emery wheel or cutter; fig. 8 is an end view of the slotted table, showing the bolt and socket for holding the circular saw; and fig. 9 is a plan view, showing the circular saw under the action of the cutting wheel.

A, A, is a standard, carrying at its upper end the rocking table, and is provided with adjustable and fixed brackets for carrying the various working parts of the machine; B is the driving shaft (mounted in two journals fixed on the bottom flange of the standard A, A) carrying the fast and loose belt pullies C, C, and also a grooved driving pulley C^1, which transmits rotary motion through a band to a grooved pulley E^1 on the end of a short shaft E, carried by a headstock E^1. This headstock slides upon a bracket, D, projecting from the back of the standard A. Upon the fixed bracket is mounted a weighted crank lever E^2, which by pressing against an adjusting screw E_3, connected with the headstock, keeps the driving band at the proper tension. The short shaft E (mounted in headstock E^1) carries two grooved pullies F, F, for the purpose to be presently explained.

On the front face of standard A the bracket G slides vertically, supported by a vertical screw H, which passes through a nut I, provided with a rim, and resting upon the bottom flange of the hollow casting, so as to be easily turned round. The bracket is held in its proper position by a bolt (fig. 2) fitting into a slot in the standard A. Upon the bracket G is fitted the turntable J, J, in which are cast segment slots for receiving bolts, which by means of thumb-nuts hold it firmly to the bracket. In suitable brackets, forming part of this turntable, are mounted the shafts K, K (fig. 4), to each of which is keyed a guide pulley, K^1, K^1.

On two other projections from the turntable, J, J, is mounted the rocking frame L, which carries at its upper end the cutter shaft L^1, with its driving pulley and emery wheel or other cutter; L^2 is an endless driving band, which, passing round one of the pulleys F, to and under the guide pulleys K_1, and thence over the grooved pulley of the cutting wheel, communicates motion to the cutting wheel.

On the top of the standard A is mounted the rocking table M, carried by the bolts M^1, M^1. A segmental slot is made in the front end of the table to receive a bolt M^2 for holding the table at any required angle. Upon table M is bolted the compound clamp, by which the blade or web saw is presented to the cutting wheel. This compound clamp consists of an adjustable standard O, attached to the table by a nut screwed on to a clamping bolt, the head of which is shaped to slide in the longitudinal groove formed in the face of the table (fig. 3). On the front face of this standard is an L-shaped slide, O^1, which moves over, and is supported by L-shaped guides. The horizontal portion of this slide O^1 forms the under jaw of a clamp, in which the saw blade to be sharpened is placed. Over this jaw is placed a loose jaw, O^2, which when the blade is in place (fig. 2) is screwed down (as shown in fig. 5). At the back of slide O is a rack (1), into the teeth of which a pinion (2) takes. This pinion is keyed to a short axle, supported in the standard O, and carrying at its upper end a hand wheel. A traverse motion is given to the clamp by turning this hand wheel, and thus the teeth of the saw are each in succession brought under the action of the emery or other cutting wheel.

Adjustable stops may be provided on the turntable for limiting the amount of vibration of the cutter frame L, both towards and from the work. A tendency is given to the cutting wheel to leave the work by weighting the cutter frame at its lower end, as shown at figs. 1 and 2; and handles are provided at the upper end of the frame to enable the attendant to bring up the wheel to its work. By means of an adjustable stop it will be obvious that the depth of cut may be accurately determined. The "tension" crank lever, E^2, is forked at one end (shown in detached views, figs. 5*, which represent it in partial side and edge views) and it embraces a collar fitted with pins, which take into slots in the fork. Into the collar fits the end of the screw E_3, which rests in a bearing in the bracket D, and passes through a tapped lug pendant from the headstock E^1. When the weighted limb of the crank lever drops out of the horizontal line, it may be brought up to position by turning the adjusting screw, and thrusting back the upper limb of the crank lever.

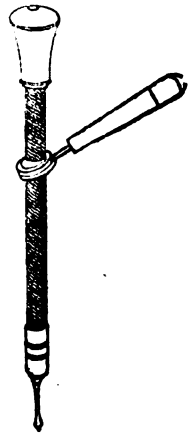
It will now be understood that the machine admits, first, of the saw blade being presented to the cutting wheel at any desired angle from a horizontal line in order to form an inclined cut; second, besides the depth of cut being variable as desired, that any amount of chamfer or undercut may be given to the tooth by simply raising or lowering the cutting wheel frame; and, third, that from the cutter frame being mounted on a rising and falling turntable, the angle of the chamfer cut may be adjusted to suit any inclination of gullet tooth.

When it is required to sharpen circular saws remove the slide O, and substitute for it the arrangement shown at figs. 7 and 8. The bolt, N, is somewhat similar to that which slides in the groove of the table M, and secures the slide O (fig. 2) firmly thereto; but in this case the bolt is provided with suitable socket and nut for gripping the saw, in addition to the clamping nut, which secures the bolt in position on the table, which position is determined according to the diameter of the saw to be sharpened. A rest (P) is provided at the front end of the table for the circular saw, in order to prevent its vibrating under the action of the cutting wheel.

In order to ensure the proper step-by-step motion of the saw (whether straight or circular) past the cutting wheel, adopt any of the contrivances now in use for insuring regularity of feed.

SCREW DRILLSTOCK.

There are many purposes to which our readers will find the annexed drillstock, known as MacDowall's, very applicable. It acts by reciprocating motion, and consists of a rod of the so-called pinion wire. The one end of the wire is bored up to serve as a socket for receiving the drills, the other end is formed into a centre point, and contained within handle or socket, by which the instrument is guided to and pressed into the work. The remainder of the instrument consists of a slider or nut, fitted to the ribs of the pinion wire, and having a handle with a universal joint. Were the grooves of the pinion wire straight like the flutes of a column, the nut



might be slid up and down without giving any motion to the drill, but the wire being twisted to the extent of two or three turns in its length, like a very oblique screw, every ascent or descent of the handle of course causes a circular reciprocating motion of the drillstock, and fulfills the office of the drill bow of the breast drill, or the cross staff of the upright or pump-drill. This instrument does nicely for small holes, but additions have been made by the inventor which much increase its power. First was added a transverse or diametrical arm at the foot, carrying two momentum balls, but these gave inconvenience at starting and stopping suddenly. This defect was remedied by introducing a little catch wheel or ratchet in the nut, by which, as in the Brequet watch key, &c., the catch slips over the teeth of the ratchet wheel in the ascent, and only moves the drill in the descent; thus allowing the fly to act uninterruptedly and impel the drill with continuous motion in the one direction only, and with increased force, and pierces holes of fully twice the diameter of those bored by the simpler drill.

SWEDENBORG.—No. II.

(*Continued from page* 55.)

ONE of Swedenborg's discoveries about this period (1720-21) was that of the gradual subsidence of the Baltic Sea, which, with his geological observations in the field, says Mr. E. Rich, led him to conclude that deep waters once covered the dry ground. He also explained the translation of the huge boulders which are dropped here and there over the plains. In 1721, at the age of 33, our author visited Holland a second time, to examine the mines and smelting works, and to study the natural sciences; and, besides contributing to the Swedish "Transactions," he published at Amsterdam, "Some Specimens of Works on the Principles of Natural Philosophy, comprising New Attempts to explain the Phenomena of Chemistry and Physics by Geometry;" "Observations and Discoveries respecting Iron and Fire, and particularly respecting the Elemental Nature of Fire, with a new construction of Stoves;" "A new Mechanical Plan of constructing Docks and Dikes;" A mode of Discovering the Powers of Vessels, by the Application of Mechanical Principles;" "New Rules for Maintaining Heat in Rooms;" An Elucidation of a Law of Hydrostatics," referred to above; "A new Mechanical Plan of Constructing Docks, whereby Vessels may be repaired in Harbours that are not reached by the Tides;" and "A new Construction of Dams our Moles, for Arresting the Course of Rivers, Torrents, &c." The principle of the hot-air stove, then, was discovered nearly a century and a half ago. In 1722 our author published in Leipsic his "Miscellaneous Observations about Natural Things, especially about Minerals, Iron, and Fire; on the Strata of Mountains; and an Essay on Crystallization." "The beginning of Nature," he says, "is identical with the beginning of Geometry;" he therefore attempted to traverse chemical essence and combination by the fixed truths of Mathematics, and to carry the pure sciences into those which are mixed. From a London magazine of 1830 we quote—"The science of crystallography is of recent origin, and has lately attracted the notice of some very able men. Nearly all simple substances and many of the compounds formed in Nature have regular forms. * * The basis of the science is an analysis of the various figures, so that they may be reduced to a very few simple forms, which, by addition one to the other, may make all existing varieties. This subject is mentioned in a work on Chemical Philosophy published in Paris, by M. Dumas, a gentleman of much and deserved celebrity. M. Dumas distinctly ascribes to to Swedenborg the modern origin of the science of crystallography. He says, 'It is then to him we are indebted for the first idea of making cubes, tetraedes, pyramids, and the different crystalline forms, by grouping the spheres; and it is an idea which has since been renewed by several distinguished men.'" The subject of the central fire of the earth has brought forth so many papers and speculations, especially, it may be remembered, the celebrated contributions to the *Times*, respecting the varying depths of fire-strata, that we cannot omit a short extract from the "Miscellaneous Observations," in which our author says—"I admit that it is undeniable that a certain subterranean fire really exists, that is to say, that in some parts of the earth's crust a degree of heat is perceptible, which causes thermal springs, volcanic eruptions, and many other phenomena; but whether this heat proceeds from the earth's centre, and whether there be a cavity full of fire, or an igneous void—this is to the last degree questionable, and for the following reasons: 1. Because fire cannot live, unless it be enclosed in hard bodies, as in carbonaceous matter already mentioned as shut up with the fire in a furnace. 2. But if the furnace contain no solid fuel, although it be full of flames, no sooner is it closed than the fire dies out, lasting in fact no longer than the heat remains in the hard bodies. Consequently fire cannot be kept in a cavity unless solid substances be present. If, therefore, there be any heat in the centre (supposing a central vacuum to exist), such heat must come from the substances of the crust, instead of the crustal heat proceeding from the centre. 3. Hence we may conclude that heat exists in many parts of the earth's crust, and not in others." The subjects of Light, Sight, and Sound, are beautifully treated, and the reader of works issued in the present day will be surprised to find in the researches of Swedenborg much of what is now accepted, and more of what will yet become widely known. In the preface to this treatise on the principles of Chemistry he observes that physics and chemistry are essentially geometrical, and that the variety of experiments in both can be nothing more than variety in

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position, figure, weight, and motion of the particles of bodies, consequently, that the facts of these sciences must indicate the geometrical forms and mechanical motions of the elements of substances. He did not doubt that chemistry, in its inmost, was amenable to the rules of mechanics, and that there was nothing necessarily mysterious in it. His theory is that roundness is the form adapted to motion; that the particles of fluids, and specifically of water, are round hollow spherules, with a subtle matter, identical with ether, or caloric, in their interiors and interstices (which, by the way, is now accepted by some who write on the generation of steam); that the crustal portion of each particle is formed of lesser particles, and so on; water being, in this way, the sixth dimension, or the result of the sixth grouping of the particles; that the interstices of the fluids furnish the original mould of the solids—and so on.

At this time in (1724) he received an invitation to accept the Professorship of pure mechanics at the University of Upsala, which, however, he declined, In 1729 he became a member of the Royal Academy of Sciences at Stockholm, and was a most active member, communicating all he thought would be of interest to his fellow men which came under his physical and mental observation. As to the keeping of things—discoveries and thoughts,—secret, hear him speak: "There are persons who love to hold their knowledge for themselves alone * * * How low and drooping their aspirations, and how ungenerous their air! For surely no man has a right to hold his knowledge for himself alone, but rather for others, and for the whole learned world. I grant, indeed, that such characters perhaps possess secrets of some importance which they have got for a small price from those who make all knowledge an article of sale, and whose venal information a few coins will purchase. But why, then, should such secrets be grudged to the public?—why withheld from this enlightened age? Whatever is worthy to be known should be by all means brought to the great and general market of the world. The rights of civilized man convince us of this; the natural function of the individual, equally with the laws of the republic of letters, attests and enforces it. In short, unless we all contribute to the best of our power to make the arts and sciences flourish more and more, in order that eventually they may arrive at that goal which has been the desire of all former ages,—unless we do this, we can neither grow happier nor wiser with time."* I fancy if the recommendation embodied herein were carried out, the Patent Agents generally would find their occupation gone. The paragraph is herewith made a present of to the advocates against Patent Rights.

In May, 1733, he went "abroad" for the third time, for the purpose of acquiring certain knowledge necessary to the successful development of his great work (which he had long been labouring at) in three folio volumes, of 500 pages each—entitled "Philosophical and Mineral Works." Though there are three distinct works, they were all published together, and spoken of by our author as one. The first volume is called "The Principia, or the First Principles of Natural Things," and in it the author attempts to arrive at the cause, or origin, of the universe, by modes of inquiry peculiar to himself. He takes the position, that Nature, in all her operations, is governed by one and the same general law, and is always consistent with herself: hence, he says, there is necessity in explaining her hidden recesses to multiply experiments by observation. The means leading to true philosophy he represents as threefold. 1. A knowledge of facts, or experimental observation—Experience. 2. Orderly arrangement of these facts, phenomena, or effects—Geometry or Rational Philosophy. 3. Analyzing, comparing, and combining these facts after they have been reduced to order—Faculty of Reasoning. Among other positions, he takes this—proved by modern science—that "it is possible that many things of opposite natures, may exist from the same first cause: as fire and water, and air, which absorbs them both." It may here be stated that the whole expense of the production of this work was borne by the then Duke of Brunswick, at whose Court Swedenborg was always a welcome and an honoured guest. Its practical value has not always failed of recognition. The authors of the "Description des Arts et Metiers" translated a portion and inserted it in their collection, and Dr. Cromwell Mortimer, the then Secretary of our Royal Society, alluded to it in the translation of Cramer's "Elements of the Art of Assaying Metal," as "a magnificent and laborious work."

(*To be continued.*)

*Preface to the Treatise on Iron in "Mineral Kingdom." English Edition of the Principia, vol. 2 p. 371. (London: Alvey, Bloomsbury-street.)

ANSWERS TO CORRESPONDENTS.

G. H. MULHOLLAND will greatly favour us by forwarding another drawing of his furnace bar.

C. HAATSCH.—Favour us with another sketch. The printers have lost or mislaid the one enclosed in your letter of the 19th.

H. HURST.—Will you kindly forward, another drawing and description.

F. ALLEN (Ayrshire).—Received; but cannot undertake to engrave.

WILLIAM MALTBY.—We have forgotten the number. Write to the office of the journal, and you will receive the required information.

G. G.—Received.

ALEX. M'DOWAN.—We should advise our correspondent to join some scientific institute or society in the town, and to attend all the lectures that he conveniently can. Let him also persevere in the study of sound writers.

J. H. W. G.—Yes, at an early date.

CHARLES NEWCOME.—We shall be glad to look over your receipts.

VELOCIPEDE.—Engravings will shortly appear.

H. HUXLEY is thanked, but we cannot engrave from the drawings forwarded. He must send others more correct.

S. B. (Ipswich).—Received, with thanks. It has taken you a long time to make the experiment. The directions were copied from a first-class publication. We are sorry, for your own sake, at your determination.

PHILOS.—Send to Effingham Wilson, bookseller, Royal Exchange, with a stamped envelope—you will get an answer by return of post. Or the same to Routledge, Broadway, Ludgate-hill.

X. Y. Z. (Chester-le-street)—Will be attended to.

J. W. J.—If you will inquire at Holtzapffel's, in Long-acre, or Spon's, in Bucklersbury, they will give you a catalogue of good works to select from.

SERGT.-MAJOR EAST (Putney).—Why not place yourself in communication with the gentleman?

THOS. GREEN (Liverpool).—We really do not understand what you require. We remember looking at a drawing of a coal-cutting machine, and giving an opinion of it in, we think, the number following.

DANIEL MCCANN (Glasgow).—Our best thanks for your sensible, manly, workmanlike letter. In this column, last week, you will find an answer to one of your queries. Gutta-percha will do for your second.

GEO. RICE.—Sorry we cannot oblige you The patentee would have to be written to; or it might be had through a patent agent, who does business for Americans in this country. Try Haseltine, Chancery-lane.

R. W. (Asphestos).—Steep the wood in lukewarm water with a little alum, for two or three days, then put a handful of logwood, cut small, into a pint of water, and boil it down to less than half; add a very little indigo. Spread a little of this liquid on the wood, dry, give another coat; dry, another coat. Then boil verdigris in its own vinegar, and spread on the wood. When dry, rub with oiled chamois leather.—1½ oz. shellac, ½ oz. each gums mastic and sandarac, spirits of wine 20 oz. Dissolve gum first in spirit, lastly shellac; put on two or three coats; polish with Tripoli and water, and finish with suet and flour, rubbing to a good polish. You can buy the varnish.

W. HADLEY.—The first has had a slight refining treatment, the latter has lost part of its property in the furnace, and has to be re-melted with other iron containing a superabundance of what the burnt iron has lost.

ALB. MAGNUS.—Printers simply stretch theirs, and damp it while stretched—that is all.

R. M. (Harwich).—Boil up a lye (in a copper) of soda, ash, lime, and water. Then cool, and carbonate of lime is deposited; next draw off the lye, and add it to the tallow, fat, or oil, in the proportion of 150 gallons of lye to a ton of fat. Then set the steam under it again, adding stronger lye until there is no greasy peel. Common salt is added to separate the glycerine and other impurities derived from the grease. These are drawn off, stronger lyes added, until the whole soap separates. It is then transferred to cooling frames, and when hard is cut into bars (see query number 2 in proper place).

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

A PIECE of amber weighing 13lb. was valued at Constantinople at 30,000 dollars.

DR. BACONIO, of Milan, has shown that a few alternations of slices of beetroot and wood of the walnut tree are capable of setting free sufficient electricity to excite convulsions in a frog, when conveyed to its muscles by means of a conductor formed of a leaf of scurvy-grass.

THE intervals or distances of the waves of red light from one another, in the succession which they follow one another to produce extreme red, are such that there are 37,640 to an inch; of yellow, 42,550; of green, 47,460; blue, 52,910; extreme violet, 59,750; mixed or white light waves, 44,440.

NOTICE TO ADVERTISERS.

ADVERTISERS in this journal are respectfully informed that the Collector from the office, 162, Fleet-street, will call upon them for a settlement of the amounts due for the insertion of advertisements. The Collector will in every instance hand in a printed receipt for the sum paid to him. Advertisers are particularly cautioned against paying money without receiving the printed receipt.

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Post-Office Orders to be made payable to GEORGE MADDICK, Fleet Street Branch.

All Advertisements should be sent to us not later than Friday.

The English Mechanic.

FRIDAY, NOVEMBER 3RD, 1865.

THE CUTLERY TRADE OF SHEFFIELD.

THE Commissioners appointed by Government to visit our manufacturing centres—including Sheffield—have made out an apparently sad case indeed, have presented as horrifying details in connection with some of the trades as might be supposed to have existed about the time of Peterloo, when working-men were generally looked upon by those above them as simple perambulating tools, and who were indeed in very many cases but little

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removed from the beasts. The cutlers of Sheffield have been singled out by the Press as deserving of special protection by the Legislature: their term of life was set down at one score year and ten, they were designated a race of prematurely old deformed cripples, who, did they reach the old age of thirty-six, had out of that time been working thirty, according to usual computation—according to comparison of working hours, 45 years—that is, allowing 6 hours or thereabouts for sleep and leisure, the remainder for work. But it will have occurred to many that Sheffield is not full of cripples, so as to give correctness to the picture drawn in the Parliamentary Blue Books; as also it will to some, that in various shops in the cutlery town there are now at work three generations of cutlers, among whom there is not one cripple. There is no denying, however, that there does exist a great deal of misery, want, and depravity, and that the death-rate is very high—neither is it, that much of this is brought about by the workmen themselves, and a certain class of masters who take advantage of the criminal conduct of their men to "keep their noses at the grindstone." We will take the case as stated by one of themselves, and leave the reader to judge between that made out by the Commissioners and the thing as it exists. The workman goes into the warehouse on Monday perhaps, gets a job out, and takes it into the shop; but instead of starting on it at once, he starts talking round with his shopmates, one of whom, let us say, has got a "tip" on what is known in sporting circles as a "handicap;" and as that gentleman considers his "tip" as a certainty, his mates and he go off and "lay the odds," or whatever it is called, with the money that should be laid out on files. The shop sees the man no more till Tuesday, and then he is not in order for work, so, as it is market day, off he sets for a turn among the greens and potatoes to waken him up a bit; but the afternoon finds him where he got in liquor on the previous night, with his shirt sleeves turned up, hard at work among dominoes. Of course before night what was left of money is gone, and he plays and drinks on—on tick. Thus the first two days are gone. On Wednesday morning he begins what is now a scuffle instead of work. Of course he has not the proper number or sort of files to work with, and work that he ought to file he does on the rough emery glazer, and by-and-by fills the shop with bone, steel, and black buffalo dust, or pearl dust. With all this "scuffling"—and assistance to disease—he cannot earn a week's wages, so he "writes on account," or, as it is termed, has a lot of "sours" put down, to rub off the Tuesday's score. A week or two further on his "sours" are so heavy that it takes him a week to sweeten them, and thus has no wages on that Saturday night. Debt is contracted on every hand; and the class represented by this man are never one penny before a beggar; their children they never think of sending to school, but put them to the trade as soon as they are able to do anything to make up for their own shortcomings. As a matter of course, the "masters" who employ such "men" have few scruples remaining—"like master like man," and the poor dolts are taken advantage of at every turn. This is true, more especially of a lot among the spring knife cutters, who have the shadow of a union, and if its secretary wouldn't mind telling his experience, he could tell of want of principle and manliness, of stupidity, and of degrading sensuality. As for the crooked legs, arms, and backs, that might have been true when the leg frame was in vogue; there is very little truth attachable to the statement now. As for the price paid for the work done, here more than anywhere else it depends on the men. Were they sober, honest, and industrious as a rule, they would easily get sufficient to enable them to keep themselves and families decently and respectably, and to send their children to school. What Government should do, is not to allow a girl in the trade before she has reached 12 years of age, or a boy till he has turned 11 years; to amend the parish school system and enforce the sending of children to school. If the difference were not all seen in this generation, it would in the next; and that is grand legislation which looks also to benefit in the future. Wherever in Sheffield the cutlers are steady and good workmen, they seem to get along pretty well: they don't seem to die off at thirty, forty, or fifty; neither are they deformed and cripples. And it is to one of these respectable mechanics we are indebted for the above necessary corrections on the report of the Factory Commissioners, which report, so far as it relates to a *part* only of this same cutlery business, is correct—no further.—F. S.

GAUGES FOR WIRE AND SHEET METAL.

WE have at different times been solicited to give a table with explanatory notes of the values of gauges for wire and sheet metal in general use, expressed in decimal parts of the inch, and in pounds weight and decimal parts of a pound for plates. The delay in publishing this has been caused chiefly by waiting to see if such a thing would be of use to any number of our readers: finding that it is so, we give it, as follows:—

Weight of Plate.	§ 1. Birmingham Gauge for Iron Wire, and for Sheet Iron and Steel.		§ 2. Birmingham Gauge for Sheet Metals, Gold, Silver, &c.	§ 3. Lancashire Guage for round Steel Wire, and also for Pinion Wire. The smaller sizes distinguished by numbers: The larger by letters—called the Letter Gauge.			
lbs.	Mark	Size	Mark Size	Mark	Size	Mark	Size
18·16	0000	·454	1 ·004	80	·013	40	·096
17·00	000	·425	2 ·005	79	·014	39	·098
15·20	00	·380	3 ·008	78	·015	38	·100
13·60	0	·340	4 ·010	77	·016	37	·102
12.52	1	·313	5 ·013	76	·018	36	·105
11·36	2	·284	6 ·013	75	·019	35	·107
10·36	3	·259	7 ·015	74	·022	34	·109
9·56	4	·239	8 ·016	73	·023	33	·111
8·72	5	·218	9 ·019	72	·024	32	·115
8·12	6	·203	10 ·024	71	·026	31	·118
7·48	7	·187	11 ·029	70	·027	30	·125
6·64	8	·166	12 ·034	69	·029	29	·134
5·92	9	·158	13 ·036	68	·030	28	·138
5·50	10	·137	14 ·041	67	·031	27	·141
4·80	11	·120	15 ·047	66	·032	26	·143
4·36	12	·109	16 ·051	65	·033	25	·146
3·80	13	·095	17 ·057	64	·034	24	·148
3·32	14	·083	18 ·061	63	·035	23	·150
2·88	15	·072	19 ·064	62	·036	22	·152
2·60	16	·065	20 ·067	61	·038	21	·157
2·32	17	·058	21 ·072	60	·039	20	·160
1·96	18	·049	22 ·074	59	·040	19	·164
1·68	19	·042	23 077	58	·041	18	·167
1·40	20	·035	24 ·082	57	·042	17	·169
1·28	21	·032	25 ·095	56	·044	16	·174
1·12	22	·028	26 ·103	55	·050	15	·175
1·00	23	·025	27 ·113	54	·055	14	·177
·88	24	·022	28 ·120	53	·058	13	·180
·80	25	·020	29 ·124	52	·060	12	·185
·72	26	·018	30 ·126	51	·064	11	·189
·66	27	·016	31 ·133	50	·067	10	·190
·56	28	·014	32 ·143	49	·070	9	·191
·52	29	·013	33 ·145	48	·073	8	·192
·48	30	·012	34 ·148	47	·076	7	·195
·40	31	·010	35 ·158	46	·078	6	·198
·36	32	·009	36 ·167	45	·080	5	·201
·32	33	·008		44	·084	4	·204
·28	34	·007		43	·086	3	·209
·20	35	·005		42	·091	2	·219
·16	36	·004		41	·095	1	·227

Mark	Size
A	·234
B	·238
C	·242
D	·246
E	·250
F	·257
G	·261
H	·266
I	·272
J	·277
K	·281
L	·290
M	·295
N	·302
O	·316
P	·323
Q	·332
R	·339
S	·348
T	·358
U	·368
V	·377
W	·386
X	·397
Y	·404
Z	·413
A1	·420
B1	·431
C1	·443
D1	·452
E1	·462
F1	·475
G1	·484
H1	·494

This series of measures have no relation to one another—thus, the numbers 10 of the table are different and undefined quantities, neither aliquot nor direct fractional parts of an inch, as the No. 10 notches are generally ·137, ·024, and ·190 of an inch wide.

The approximate measures of any one of these three series may be moderately familiar to those in the habit of using either one, but those persons will very likely know as little of the other two as the generality of individuals—to whom the whole are both vague and ill-defined, because their nomenclatures have no relation to the standard foot and inch.

The second column of the table (§1) refers to the gauge used for most kinds of wire, and for brevity is called the "wire gauge," though it is known by three other names. It is the most common of the three principal kinds, and is employed also for brass and other wires, for black steel wire, sheet iron, sheet steel, and various other materials, and also for screws for joiners' use, &c. The largest notch is marked 0000, and measures 454-1000ths of an inch, or nearly 4½ tenths of an inch: the smallest notch, marked 36, measures 4-1000ths, or the 1-250th part of an inch. Though this gauge seems to possess but 40 sizes, 60 are made, as intermediate sizes are added. Thus the sizes of wire drawn for manufacturing needles correspond with some of the ordinary wire sizes, but the numbers are different—

Needle wires	Nos. 6,	7,	8,	9,	10,	11,	12,	14,	16,	18,	20.
—Birmingham wire Gauge }	,, 26,	25½,	25,	24½,	24,	23½,	23,	22,	21,	20,	19.

The number 6, music wire, measures about the 1-55th part of an inch in diameter, and No. 20, the thickest, about 1-25th of an inch. The manufacturers of the patent screws made from iron wire for joiners' use also give the intervals of the wire gauge a new system of numbers. Thus, the left-hand column of the following table show the Nos. of the screws, the right-hand that of the wires from which they are made:—

No. of the Screws.	No. of the Gauge.	No. of the Screws.	No. of the Gauge.	No. of the Screws.	No. of the Gauge.
25 ...	0000	12 ...	4	5 ...	11
23 ...	000	11 ...	5	4 ...	12
22 ...	00	10 ...	6	3 ...	13
21 ...	0	9 ...	7	2 ...	14
17 ...	1	8 ...	8	1 ...	15
16 ...	2	7 ...	9	0 ...	16
14 ...	3	6 ...	10	00 ...	17
				000 ...	18

Other examples of conversions might be given, but their only use would be to show further the existing irregularity.

(To be continued.)

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions o our correspondents.]

ANGLE OF LATHE CENTRES.

By neglecting to make a correction, forwarded to us by "Kilmarnock" himself, our kind correspondents have had a great deal of unnecessary trouble and vexation. "Kilmarnock" had been misled, in the first place, by his marked gauge, the figures on which had been wrongly engraved. We discovered the error in time for that correction, which in the hurry of going to press was overlooked by us.

RADIUS OF A CURVE.

Sir,—In reply to "Hand Chisel." Multiply the height of the side by the greater diameter, and divide by the difference between the two diameters, and the product is the length of radius required. Example:—Height of side 18in., greater diameter 36in., lesser diameter 8in., difference 28in. Circumference 36×3.1416=113in. 18×36÷28=23⅔ 1-7in. Set the compasses to 23 1-7in., draw a curve for top of pattern, then set the compasses 18in. less, that is 5 1-7in, and from same centre draw the curve for bottom of pattern, and from the centre draw a straight to one end of the large curve—then from this line mark off the circumference 113in. upon the large curve, from this point draw another straight line to the centre, and you have the full size pattern required. If required in 3 equal sized pieces, mark off ⅓ the circumference 37⅔in. upon the large curve. Allowance must be made for seams and wires. If 18in. is the perpendicular height, draw a section full size of the vessel required, and measure the height of side. F. S. C.

OUR SUBSCRIBERS' NOTES AND QUERIES.

POLISHING PEARL.—Can any one tell me how to do this? —T. W.—(In answer to query 2, respecting dipping. After the work has been fitted, anneal it over the fire to red heat, and let the cooling be gradual. This heating removes dirt and grease. If the work is to be soldered, anneal before soldering, and after soldering boil in a lye of pearlash. Next pickle in dilute aquafortis—the old bath containing a small quantity of copper in solution is preferred. Let the work remain in the bath for an hour or two, according to the strength of the bath. Next scour bright with sand and water, with a scrubbing brush. Then place in clean water, waiting for the dip. This bath consists of pure nitrous acid, a sufficient quantity of which is poured into an earthen vessel to cover the work as far as required. If the whole article is not to be dipped, use brass plyers to handle it with. The bath being ready, whip the work out of the water, give it a shake, and dip it into the aquafortis for an instant only. Then plunge it into clean water to remove the acid, then immediately into hot water, next shove it rapidly into sawdust and rub until quite dry. Should the work not be bright enough, repeat the process, taking care to make the sousing in water and drying with sawdust a rapid process. The work is then burnished as rapidly as possible, where required, and lacquered as soon as possible.)

SEASONING PLAINTREE.—How can I do this, or with sycamore to prevent splitting—for rollers, 36in. long, 9in. diameter?—J. D.

TO MAKE A HOIST.—The simplest way for taking dishes from one flat to another.—J. DAVIS.

HEATING.—The best way to heat a church or hall—if with water, best shape of boiler, size of pipes, &c. Also best cement for joining the pipes.—J. D. (Glasgow.)

CEMENT.—Wanted the best, for hot-water pipes?—SEDHILL.

FRET SAW.—Will any correspondent oblige me with the drawing of a fret saw for inlaid cabinet work?—J. W. (For the other send to Spon, and he will forward you a catalogue of his works, free.)

GILDING.—What is the difference between mercurial, water, and fire gilding?—G. L. A.

BLUEING STEEL.—How is the blue colour put on the polished surface of such articles as pointers?—J. NIXON.

DIFFERENTIAL PISTON.—Can any one oblige me with a sketch of a differential piston as applied to steam hammers by the Messrs. Bramwell and Baggs in 1853?—LOCOMOTIVE.

SEPARATING LEAD FROM SOLDER.—How can I do this, to leave the lead pure?—J. BROWN.

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DYED GAS!—Can any one tell me how to produce gases, giving different colours?—JOHN TURNER.

CAPSULING MACHINE.—Where can I purchase first-rate capsuling machines?—W. W.

HEATING.—Can any one who has used it tell me how Perkin's system of heating greenhouses answers?—OLD SUBSCRIBER.

APPLYING STEAM.—Why should not steam be applied directly to shearing plates, as well as to driving the steam hammer? Also, what is the average proportion which a cylinder bears to the boiler?—R. M. M.

PRUSSIAN BLUE PULP.—How can I make Prussian blue pulp, at once, on the fire, so it will be sweet and a good bronze?—R. M.

COLLECTING ELECTRICITY.—Will this do, in place of Leyden jars? Two layers of sheet caoutchouc alternated with 2 layers of tinfoil and rolled up, but so arranged that one layer of foil could be connected to the machine and the other with the earth.—HY. GORNALL.

GRADUATING.—How can I get two circles of 12 inches in diameter finely graduated?—ASTRONOMICUS.

THE MICROSCOPE.—How can I cut the very thin glass on which microscopic objects are mounted? They are perfectly round and as thin as a wafer?—C. SMART.

HYDRATE OF ALUMINA.—J. R. will be obliged to J. H. M. if he would inform him how to make hydrate of alumina, as he cannot obtain it at any of the druggists in the town.

SLEDGE HAMMER FORCE.—Can you inform me as to what is the equivalent in tons pressure, to the effect of a blow of a sledge hammer given by a man of ordinary strength, the sledge hammer weighing 20lbs.?—R. O. S.

WATERPROOF.—How can I make a good waterproof that will dry quick, for fishing stockings of a cotton material?—F. A.

INJECTION PIPE.—What is the size of injection pipes required for engine indicating 130 horse-power, diameter of air pump 23 inches length of stroke 15 inches, 50 strokes per minute?—J. SEDDON.

PARALLEL MOTION.—How can I set a parallel motion?—FITTER.

OBJECT GLASSES.

Sir,—In reply to Mr. T. Edmonds, in No. 26, I beg to say that the focal length of the object glass which he requires is about 16 inches. The image should be formed by it just in front of the 4" lens of the eye piece, and, as the latter is 6 inches long, allowing an inch for adjustment, 23 − 6 − 1 = 16.

The enquiry of Swede, in No. 27, is rather vague; but he will find the fullest account of grinding and polishing lenses, in Vol. 3 of Holtzapffel's "Turning and Mechanical Manipulation," p.p. 1262 to 1274; also, less detailed ones in "Herschel on the Telescope" (price, 3s. 6d., A. & C. Black) and "Pritchard on Optical Instruments," one of the Useful Knowledge Society's eighteenpenny books, published, I think, by Baldwin. These last two works contain also a table end formulæ for computing the curves of object glasses.

No amateur can possibly produce the proper glass "in a raw state." It can only be obtained of the Messrs. Chance and Co. of Birmingham. AN AMATEUR TURNER.

CORRECTION, &c.

Sir,—In my letter on clocks published in No. 30, "Robbin" should be "Roblin."

Young Mechanic can obtain a small book from Aston, 25, Old Compton-street, Soho, which will tell him all about the slide rule.

Crank turning: In I. M.'s diagram, the left side of the crank should be stayed as well as the right. W. J. F.

Sir,—In reply to Tyro, No. 30, there is no difference in the power of screws of various number of threads in diameter, so long as the pitch remains the same. There is a difference in the amount of power they absorb. PLIAS.

ECCENTRIC SHEAVE.

Sir,—There is a slight mistake in the explanation of the diagram of the eccentric sheave I sent you. The words "lever advance" are used instead of "linear advance." The letter T should have been I. JAMES MORRISON.

FUR IN KETTLES, &c.

Sir,—In reply to T. G. Moreland. The incrustation deposited on metallic surfaces by precipitation of the earthy impurities in the water speedily shells off when potatoes are boiled for a few hours in the vessel. F. G. M.

HOW TO BLEACH TALLOW AND RESIN.

Sir,—These gentlemen are trespassing on dangerous ground, and if badly in want of the information asked for should purchase at the Patent Office specifications of the several inventions relating to these subjects, not forgetting while searching the old adage that "Honesty is the best policy," and that "frustraters" are liable to legal penalties for infringement. F. G. M.

WORKS ON TURNERY.

Sir,—Referring to the excellent list of works on Turnery in your journal, I find that Bergeron's "Manuel du Tourneur" is dropped out of Rovet's catalogue of December last. It is not in the series "Encyclopedie-Rovet," but in another, entitled "Industrie Art, et Metiers," price about £2 10s. But I think Williams and Norgate, of 14, Henrietta-street, Covent-garden, continue to supply it. If I understand the observations of your contributors, it is not superseded by the work of Valicourt in the "Encyclopedie." The title of this latter in the catalogue of the Encyclopedie-Rovet is "Tourneur, au Traite complet et simplifie de cet Art, d' apres les reinseignements de plusieurs. Tourneurs de la Capitale: par M. de Valicourt. 2 Vol., avec un Atlas in 4, de 29 planches, 12 francs." This differs somewhat from the title given in your contributor's list. Is it the same work? Its price does not indicate comprehensiveness, but it may be a sufficient guide to the practice of plain turning. BETA.

WORKS ON TURNERY.

With respect to a recent suggestion in our columns of a compilation from existing standard books on the subject, to supply the incompleteness of the late Mr. Charles Holtzapffel's great work, it is understood that the present representative of a name so dear to all mechanicians, professional and amateur, is in possession of the ample materials amassed by his honoured father, for the completion of his work; and, moreover, that he is abundantly qualified for the task of reducing these into shape for publication, in the same admirably simple, yet lucid style, that characterises the volumes already published, and also to bring down the work to the latest extensions and improvements in the art It is earnestly to be desired that Mr. John I. Holtzapffel might, even amidst the pressing exigencies of extensive and engrossing business avocations, spare as much of his time as to complete a task that may be said to devolve on him by inheritance. No doubt, scientific works of this high class, involving as they do vast research, labour, and cost, are rarely, if ever, remunerative to the author; so that it would necessarily be with Mr. Holtzapffel a "labour of love;" but he has the inducement of knowing that, in accomplishing it, he would bestow an inestimable benefit on a country so deeply interested in the science and art of mechanical engineering as this is, and at the same time fulfil what the public will be apt to look upon as a trust imposed upon him by his position, as the representative of a family which, for three generations, has been so eminent in the annals of the profession. B.

OIL FOR CLOCKS.

Sir,—If E. Feather will get a 2-ounce bottle full of the best sweet oil, and put into it about half an ounce of lead, and let it stand for a few days before using it, he will have a very good oil for clocks. I had the mode recommended to me as the best and easiest way to purify it, and I have tried it and it answers well. The lead should be near the length of the bottle, and may remain in until the oil is used up. R. F. W.

Sir,—Having broke a first-rate whetstone, I should be much obliged to any of my fellow workmen who could tell me of a cement to join together that would not affect the pool in passing over it. R. F. W.

Sir,—In answer to Perambulator, coach paint is prepared much the same as colours used by house-painters. With the exception of the better colours such as blue, lakes, &c., those are generally prepared for use in varnish. There are varnishes prepared for coach painters' use, suitable for the various purposes of coach painting. If Perambulator will send his address to your magazine, I should be very willing to call on him and give him any information on the subject he may desire. COACH PAINTER.

PENTAGRAPH.

Sir,—In a former number an enquiry is made for a description of Taylor's pentagraph machine for engraving cylinders. The best description is contained in Taylor's specification, which may be met with at the Patent Office. The date is 1848; but I forget further particulars. Improvements have been made and patented, 1862, No. 2307, by the writer. H. E.

MAHOGANY DYE.

Sir,—In answer to Z. Y. X., he can make a very good mahogany dye by boiling logwood, and giving the work two or three coats, and in the last coat put a small quantity of American potash; if too much potash, the work will be turned very dark. J. W.

BAGATELLE CUE TIPS.

Sir,—In answer to J. W. Moore, I have seen in shops where bagatelles are made a white leather about one-eighth of an inch thick put on with glue. First, glue the end of the cue, and leave it dry; then give it a second coating, and put the leather on. The first coat prevents the second going into the end grain of the cue. J. W.

[Send on your tracing and description, and we will do the best we can.]

STEAM PRESSURE.

Sir,—In answer to J. E. M., the pressure of steam upon each piston will be the same; for the effective surface of a piston cannot be greater or less than the area of the cylinder—that is, if it fits, of course. The one marked F would perhaps be the least effective, in consequence of the increased friction upon the one side of the cylinder by the pressure of the steam. F. H. F.

STEAM HAMMER.

Sir,—In reply to T. Y., the amount of work done by the steam hammer in the case put, would be equal to 929·6 foot pounds; but there is no means of rendering this comparable with the effect produced by dead weight, since, unless the dead weight, moved (however infinitessimal the space might be through which the motion occurred) no work could be done by it.

A strange error has crept into the concluding portion of Aspirant's solution of the difficulties of R. E. Mellor, it being stated that the formula given being applied to the case in point "gives ·07 inches as bursting power." W. TONKES.

RAISING A COLUMN OF WATER.

Sir,—As Fred wants to know of some mechanical means to raise a column of water in a three-quarter inch pipe to the 20 yards:—

Let him get a small force pump—or two, if he thinks fit—connected on a crank shaft, the one opposite the other, and let him key a small water-wheel on to the end of the crank shaft, and place it so that the water will fall upon it, and I think it will answer his purpose. JAMES MORRISON.

MAHOGANY DYE.

Sir,—Z. Y. X., No. 29, will find the following a good mahogany dye:—

Boil equal parts of madder and Brazil wood, add a little log wood, brush the work over while hot; when dry, paper the roughness down with fine glass paper, and if the colour is not deep enough, add a little dragon's blood with the polish. T. W.

FURNACE BARS.

Sir,—I thank Mr. T. Jackson for his information about furnace bars. Will he be kind enough to give a more clear description of his bar, as to the thickness and so on, the small figures, &c., not being distinct, and sketch? H. PRITCHARD.

FALLING BODIES.

Sir,—With regard to the question of falling bodies put by J. L., the attraction of gravitation, as a matter of comparison, has nothing to do with either the density or specific gravity of various bodies. However large the mass, or whatever the nature of its constituent particles may be, the earth attracts each particle alike, and with the same degree of force; hence, each would approach the centre of attraction with the same velocity, whether free from, or bound in union with, any number of similar atoms. The real difficulty of J. L. lies in the obverse of attraction, viz., an opposing force to its exertion, then the question of mass becomes one of serious consideration. Take two bodies, one of a single atom, the other one million atoms; to attract the first a force represented by one only would be required; but the force of one million times as great must be exerted before motion could be produced in the other, and, since this force is distributed over one million atoms, why should we look for an increase of velocity? We have no reason to do so—we do it not, and we never find ourselves disappointed; but were we to place the same resistance to this force to oppose the motion of the million particles, that would effectually arrest the single one, then we should find that though there was no greater velocity, there was still an exertion of one million times in active operation. W. TONKES.

TO SAVE VARNISH.

Sir,—The glue size recommended by New Leeds, and Amateur Turner, although it fills up the pores, obscures the surface. The following composition should therefore be used preferentially, as it fetches up and causes the natural grain of the wood to bear out and indelibly strikes in any required tone of stain applied for increasing the colour and general effect of the work. The recipe is gum shellac, 1lb; methylated finish, 1 quart. When the gum is thoroughly dissolved by the aid of gentle heat and frequent shaking, dilute with the spirit to required consistency for use. This simple and inexpensive admixture is from its adhesiveness and durability of peculiar value in a factory for coating patterns, particularly those for bushes of journals, pinions or wheels of low pitch in which the fibres of the mahogany or pine must be presented endwise to the surface, therefore the edges are apt to be broken away; in all such cases the application of one or two coats to the work while new will render it impervious to damp—capable of withstanding a higher than ordinary degree of temperature, and by imparting uniform smoothness of surface necessarily expedite the operation of moulding. F. G. M.

BOILER CONSTRUCTION.

Sir,—A. Neison, in your number for October 13, proposes to have his boiler made of two feet lengths, each length composed of four pieces, the longitudinal joints to be rivetted with strips, the transverse joints to be encircled by a hoop. This description of boiler would be a very heavy one, and it would only add strength to the boiler equal to the area of cross section of hoop at weakest part; but it would not possess any of the advantages claimed for it by your correspondent.

Two thicknesses of iron in a boiler offer a great impediment to the transmission of heat—in fact, the outer plate will become hot, and the rivet heads more seriously heated still, and thereby cease to offer material resistance to the pressure of steam; or should they withstand the pressure, would require repairs continually owing to the leakage, &c., caused by the action of the flame, making more expensive still a very expensive boiler. The strips inside (I speak of externally fired boilers) would offer every facility for furrowing in a greater degree than the common single rivetted joint of the old boiler, and would be less effective for generating steam.

These objections apply equally to this system when applied to the construction of flues, namely: the impediment to the transmission of heat, the certainty of becoming overheated, and consequent loss of strength, and liability to furrowing.

Allow me to suggest that by having his plates 3 feet broad or more, and sufficient length to form a ring, the required size of boiler, and welding the edges together, (which by a proper system of welding would be about equal to strength of plate) then these rings rivetted together transversely would form a strong, neat, durable shell, having no rivetted joints but the transverse ones.

Then as the weakest part of a boiler is its longitudinal seams, the strength of the boiler would be increased from 34,000lbs square inch to 50,000. This speaks for itself.

Then I will conclude in the words of your correspondent slightly altered: 1, there are no weakened joints; 2, the boiler being a true circle, the strain is equal; 3, there are no longitudinal seams under water; 4, the edges of the plates not being exposed, no space for the chemicals to rest, &c. ASPIRANT

P.S. Will you have the kindness to correct an error in answer to R. E Mellor, of this week. The "·07 inches as bursting power," should read "·07 inches, equal to a bursting pressure of 490lbs square inch."

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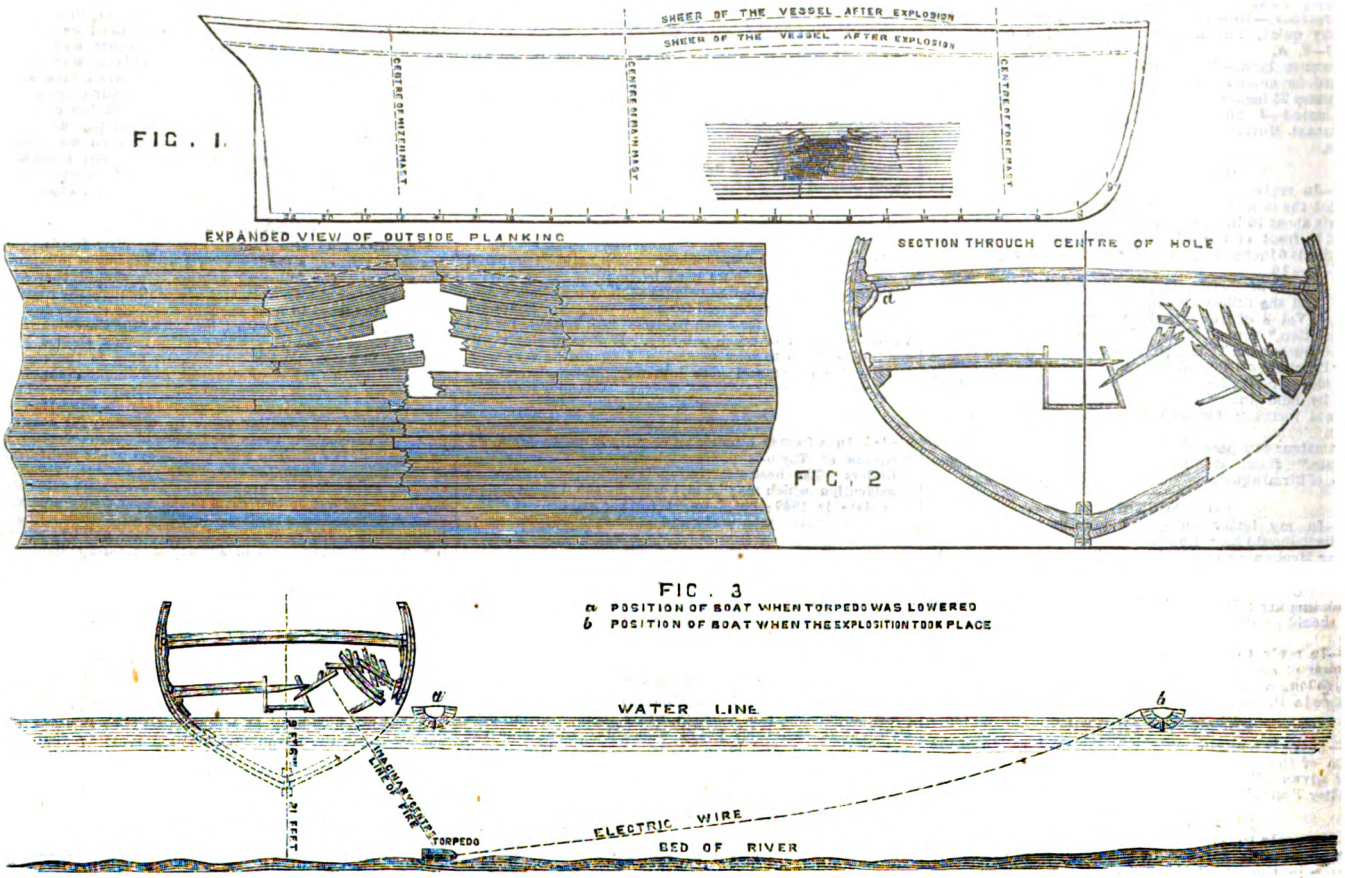
H.M.S. TERPSICHORE, AS DAMAGED BY THE AMERICAN TORPEDOES.

Two illustrations of the very striking experiments with Mr. Beardslee's submarine torpedoes, or explosive shells, exhibited on Wednesday, the 4th inst., in the River Medway, before the Duke of Somerset and other Lords of the Admiralty, were given in a recent number of *The Illustrated London News*. By favour of the naval authorities, we are now enabled to give a reduced copy of the official drawings, made for their information by Mr. P. Thornton, Master Shipwright of Chatham Dockyard, showing the exact amount of damage that was inflicted upon the hull of the old 18-gun frigate *Terpsichore* by the explosion of the two 75-pounders, of which only one was so placed that its effect could reach the vessel.

The Engraving No. 3 on this page shows the relative positions of the ship, the torpedo, and the boat from which it was fired by an electric wire: the figure *a* representing the place where the boat lay when the torpedo was lowered from its side; while the figure *b* shows the place to which the boat had been removed before the signal of firing the torpedo was given. The depth of water beneath the keel of the ship was a few inches more than 12 ft.



H.M.S. TERPSCHICORE, AS DAMAGED BY THE AMERICAN TORPEDOES.

The Engraving No. 1 shows the general longitudinal lines of the ship, with the hole made by the explosion of the torpedo, as it appeared on the 11th inst., when the *Terpsichore*, having been floated and brought into dock at Chatham, was carefully examined by the officers appointed for that purpose. An enlarged view of a portion of the outside planking around this hole is also given.

The Engraving No. 2 presents a cross section of the vessel, showing very minutely how her timbers were shivered. In the parts marked *a* the knees are seen as broken through the throat—viz., two on the starboard, and four on the port side.

GREAT CASTING OF BESSEMER'S STEEL.

The operation of casting a cubic block of steel, of the enormous weight of one hundred tons, was successfully accomplished on Tuesday week, at the new works of Messrs. Bessemer and Sons, at East Greenwich. Although this is by far the largest work of the kind ever attempted in the neighbourhood of the metropolis, it falls considerably short of what has been done by the same means and appliances in the great seats of northern industry, and notably at Bolton, in Lancashire, where a block of steel weighing 250 tons was cast, by the aid of Messrs. Ireland and Sons' patent upper-twyer cupola furnace. The purpose for which the huge mass at East Greenwich and another block of smaller size, weighing 57 tons, have been cast, is connected with one of the most important branches of modern production. Wherever iron has been hitherto used, there is a growing tendency to substitute the kind of steel which is made by the Bessemer process. Several railway lines are gradually adopting the more durable and, by consequence, the safer material; and the superiority of steel ships over those constructed of simple iron has been strikingly exemplified in the case of the Clytemnestra, which vessel rode out the hurricane or cyclone, in Calcutta river, last year, though subjected to accidents a tenth of which might have sufficed to send any ordinary ship to the bottom. With regard to the employment of Bessemer steel on railways, it has been shown that a rail of this tenacious metal may be so twisted that, in a straight length of six feet, the outer spiral edge will measure nine feet and an inch. Such a proof is of great value when the friability of common iron is considered, especially if crystallised by such intense cold as has been known to cause many accidents in Canada. One, and indeed the main peculiarity of these large castings at Messrs. Bessemer's works is in the fact that the operation is performed on the spot where the massive blocks are required for future service. It would, indeed, have been almost impossible to convey them elsewhere; and the only movement they will now undergo will consist in their being turned completely over, so that what is now the upper surface will become the base. The cupola furnace lent by Messrs. Ireland and Son for reducing the vast quantity of Bessemer steel to a liquid condition melts at the rate of thirteen tons in an hour, and is charged with three hundredweight of coke to fifty hundredweight of metal. The saving of fuel is one among many advantages belonging to these furnaces, of which there are ten at Woolwich Arsenal, effecting an economy of coke to the extent of £2,000 a year. It seems that there are about 500 of them in operation in many parts of the world, some in Germany, some in America, and one in the Island of Java. The smaller of the two blocks at East Greenwich was cast on the preceding Friday, and the upper surface was still of a purple heat and emitted sparks when scraped with an iron bar. The large mass, cast on Tuesday, will take about six weeks to cool. The liquid metal was poured into the sunken mould—a large square hole, like a tan-pit—in quantities of about four tons every twenty minutes, and the entire operation was accomplished between light and dark. These two blocks, which are within a few yards of each other, are to serve as anvils for steel hammers, when the new works of Messrs. Bessemer shall commence their active course of utility. The fine buildings, just finished, adjoin the new ship-building yard of Messrs. Maudslay, Sons, and Field, and contribute notably to the changed and thriving aspect of the once bare marshes of East Greenwich.

PHOTOGRAPHY.

PHOTOGRAPH OF THE ECLIPSE.—We understand that Mr. Warren De La Rue took a photograph of the lunar eclipse of the 4th instant. The atmosphere having been clear, the image is said to be excellent, and affords another proof of the important advantage now open to observers who make use of photography. When it is understood that an instantaneous image of a phenomenon can be taken, it will be seen that by no other means could the various movements to which our satellite is subject be so well observed and recorded as by photography. By associating this new image with one of a former eclipse, Mr. De La Rue obtains a stereoscopic effect singularly remarkable. To a practised eye the bulging hemisphere of the moon appears almost transparent, comparable to a huge glass shade covering a flat surface.

MR. CORMACK BROWN, photographic artist, of Greenwich, has published a series of photographs of various groups of the old sailors and their friends, setting out from the gates of Greenwich Hospital or lingering within the precincts, on the day of their departure. The photographs give faithful and characteristic portraits of some of those familiar figures.

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A NEW ANGLE MEASURER.*

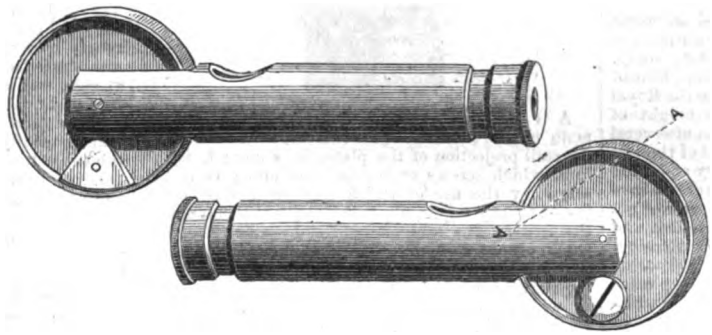
This instrument, which I have lately contrived, is on the principle of Schmalcalder's quadrant, but of dimensions small enough for the waistcoat pocket. In the Schmalcalder, moreover, a prism is used for reading off the angle at the same time that the object is viewed. In mine, the divisions are read off by a lens, and a needle point, passing through the side of the tube, and close to the divided wheel, forms the index. The object is seen with the *other* eye at the *same time*; the instrument being elevated or depressed, till the needle point appears to be in contact with the object as well as with the division of the circle. The angle of altitude is thus indicated. The drawings are of full size. I add a description and measurements of the instrument. A flanged wheel 1 1-10 inch diameter, has one half and a little more divided into degrees, the surplus being for index error; edge of wheel 2-10 wide; flange on each side about 7-100 deep. Within this flange on one side is a large-headed screw of brass, and on the opposite side a triangular piece of copper to which it is attached. The screw passes through a slotted hole in the wheel. The screw and piece of copper form a counterpoise to the wheel, and the slot allows of adjustment of the Zero point.

A brass tube 2 2-10 long and 4-10 diameter is filed out at one end so as to admit the above wheel, which is suspended as *delicately as possible* by a fine pointed screw on each side, the points of which screws enter a very fine hole, drilled in the axis of the wheel; upon the nicety of this suspension the accuracy of the instrument depends.

An aperture is made in the tube, near the wheel, to admit light for reading off the divisions, and moreover at this part the interior of the tube is silvered.

At A, a needle point passes through the side of the tube to furnish an index, as before stated.

The other end of the tube carries a lens of 1 7-10 focus, for viewing the needle point and divisions of the wheel. Some time since I gave Mr. Elliot, optician of the Strand, permission to make similar instruments if he wished to do so. He may possibly have some in stock, but of this I am not informed.



For measuring a short base line I use, with the angular instrument, a light rod of deal, 5 feet in length and ¾inch square. This is attached by a joint at the centre to a walking stick. A short base line is readily measured by this—merely marking by a scratch on the ground each length of 5 feet as you proceed. To register the number of lengths, I have a small toothed wheel, 2½ inches in diameter, which is attached to a foundation plate by a screw in its centre. A spring catch enters the teeth. Thus, by moving a tooth for each ten or other lengths of the measuring rod, an accurate account is kept. Instead of the toothed wheel an account may be kept by shifting a number of marbles from one pocket to the other.

We hope the following hint may also be of service. Having made one of the reflecting levels (a very useful pocket-companion) described in Heather's *Treatise on Mathematical Instruments*, p. 120 (Weale), I had difficulty in making the line scratched on the mirror perfectly horizontal. This difficulty may be obviated by adopting a circular instead of a square shape for the centre of the instrument. In this a cell for the mirror may be turned, and it can then be adjusted with the greatest accuracy.

A 32-POUND rocket sent up perpendicularly at Shooter's Hill is said to have risen 6,000ft., and was seen at Deal. A 24-lb. rose 4,500ft.; a ½-lb., 2,400ft.; and a ¼-lb, 1,500ft. The object was to determine the longitude on Whiston's plan.

THE velocity of waves is as the square root of their breadth. Thus, if the summits of two waves are 16ft. asunder, and of others 4ft., the velocity is 2 to 1. A pendulum equal to the breadth vibrates in the time the waves proceed.

To supply the 613 iron furnaces in blast during 1864, 10,064,890 tons of ore were required. From this and a small quantity of imported ore there were smelted 4,767,951 tons of pig iron. This was distributed over 6,338 puddling furnaces, and by the aid of 705 rolling mills, converted into merchant, bar, and other iron.

* By the Rev. N. J. Heineken in the *Journal of Science*.

BIRTH AND GROWTH OF THE IRON TRADE.

By JAMES ROBERTSON.

(*Continued from page* 52.)

Diodorus speaks of Elba, where the inhabitants dig ironstone from the ground, much of which metal is in this sort of stone; that the workmen first cut the stones in pieces, and then melt them in furnaces prepared for the purpose, and the implements made of this iron were conveyed by merchants into several parts of the world. Pliny gives a tolerable description of the manufacture of iron, and speaks of steel, and the steel-drinking cups dedicated to the temple of Mars; he also testifies as to the universality and wide diffusion of ironstone, and the tempering of iron by immersion; he also mentions the loadstone, and how Dinocrates made an arched roof thereof, in which was to be placed an iron statue of the Princess Arsinoe, so that the statue might seem to hang in air suspended by nothing.

The Turks, before they became a nation, were employed in the manufacture of arms in Asia, as you will find from Gibbon, the historian: they turned the arms they made against their masters, and founded an empire. Our earliest travellers in Africa prove the existence there of iron furnaces, blown by bellows made of goats' skins, and that the iron was made with charcoal; the furnace was of rude construction, and destroyed after every smelting, in order to obtain the iron which the bottom of the furnace contained; but in the Himalaya Mountains the Indians had a hole at the bottom of the furnace, through which the molten metal flowed; this hole was tapped with clay, so that you see the method now in use of running the iron from the furnace is of no recent date. The intercourse between the people of Cornwall and the Phœnicians and Greeks produced a remarkable degree of civilization amongst the Britons, and when Cæsar landed in this country he was opposed with weapons of iron, and discovered that the manufacture of iron had already made great progress. It is also tolerably well authenticated that our ancestors had discovered, or been taught, the arts of working tin, lead, brass, and iron, and that the Gauls traded with the Britons extensively in iron. I wonder how the ancient Britons kept their ledgers in those days, but there is nothing to satisfy our curiosity on this head. Our ancestors, under Cassibelaunus, fought with great valour: they had many thousands of chariots, armed with scythes and hooks, which did great damage to the Roman army as they charged them; and if our ancestors were somewhat barbarous, and knew but little of the arts, they gave us even then a lesson of patriotism and heroic valour, which has never yet been wanting in the hour of Englands's need, and a courage which I trust may descend unimpaired to a long line of future generations. These scythes were doubtless made in Britain, and from this period (B.C. 55), we may date the iron trade of Great Britain.

When the Roman Emperor Adrian came into Britain (A.D. 120) he established a great military forge, or arsenal, at Bath, for the construction of arms and munitions of war, whence they were distributed to the various Roman stations throughout the kingdom. This was a college of armourers, and they bore very much the same relation to the army that the artillery does to the armies of Europe in our own day. The iron was brought from the Forest of Dean and the hills of Monmouthshire, and manufactured a Bath; and the Romans continued to work the mines for 350 years (A.D. 409), about which time they finally abandoned Britain. Many traces have been found in Yorkshire and elsewhere, which gives proofs of the existence of the iron foundries of the Romans during their dominion here. The Saxon invasion paralysed the iron trade, and no mention is made of it till about the 12th century, that date at which commences the true greatness of our history, civil, political, and warlike. From the Norman conquest till the end of the reign of King John, iron and steel were imported from Germany and the Continent, and sold at steel yards by German merchants. There is no percise data to prove when the art of casting was first introduced, but cannon was used by Edward by III., in 1327; it is supposed to have been then used for the first time in England by that monarch. Cannons, or bombards as they were called, were all made of iron till the middle of the fifteenth century, when bronze was first discovered. Hardware was, during the period from 1350 to 1450, imported from the Continent, until a petition to Parliament produced an Act which prohibited the importation of swords, scissors, and knives, so that you see protectionists were strong and free traders unknown, in those early days of the iron trade; but even at that time Yorkshire and particularly Sheffield, was celebrated for its cutlery, although the cutlers could not then compete against the foreigner in the manufacture of those articles in which it can now compete, even in the face of enormous duties, against the world.

But as our manufacture advanced and developed it was arrested by a new difficulty; hitherto iron had been produced from charcoal alone, and the spacious forests of England were fast disappearing before the devouring and ever-blazing furnace. The efficiency of the Navy was then, as it is now, essential to our independence and security, and how could that be maintained if the timber of which our ships were built was taken to produce the cannon and the shot with which our ships were to be armed? The question was natural enough, the year 1558 an Act was passed forbidding the cutting of any timber for the furnace over one foot square area of the root, growing within fourteen miles of the sea, or any part of any river, so far as that river was navigable, with the exception of some parts of Kent and Sussex. Iron was then made in Sussex and in and near London, till at length ironworks were prohibited within twenty-two miles of London. Many of the ironworks were consequently stopped for want of fuel, and in the reigns of James I. and Charles I. great efforts were made to find a substitute for wood as fuel, and attempts made to smelt iron with coal; these attempts were far from successful, strange as it may appear to us, and many experiments were made, and many large fortunes lost, in endeavouring to make iron by coal instead of wood. Patents were issued by Charles I. for the new process, but these patents were unproductive to their possessors, and although high learning and the greatest intelligence of the time had been called in to aid the invention, yet it was a failure. Iron could be made by the new process, but it was not good; it was not saleable—no wonder. The nation had been used to charcoal iron, and would not be put off with cinder bars; so the patentees complained bitterly to the king and the nation—to the king, of the great losses they had sustained; to the public, that they would not see the value of their discovery, and appreciate a quality in their pit coal iron which it had never possessed.

In 1619, Edward Lord Dudley's invention of making iron with pit coal was making progress towards perfection, but his discovery was retarded in its development by the political commotion into which the State was plunged at that period; however, 300 furnaces were then at work, as we find from parliamentary reports. Lord Dudley's works were destroyed by a mob, and himself nearly ruined by his endeavours to perfect his process. For more than a century the iron trade languished, in consequence of the scarcity of fuel, and the requirements of the country were supplied from abroad, particularly Sweden and Russia. The 300 English furnaces of the previous century had dwindled down to fifty-nine, and the total production of the year 1740 was only 17,000 tons; whole production of Yorkshire was in that year 1400 tons, and Staffordshire only 1000. The demand for iron, however, was daily increasing; improvements in machinery were being made, the cumbrous bellows, worked by oxen, were discarded for the blast-engine, and the first blast cylinders of any magnitude were used at the Carron Ironworks, just 100 years ago. The quantity of iron now rapidly increased, and by the beginning of the present century the estimated production yearly was 250,000 tons. This was a tolerably rapid stride in sixty years—viz., from 1740 to 1800, in the

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former of which years the production had been only 17,000 tons. The inventions of the deceased Mr. Cort had a wonderful effect in stimulating the production of iron, and from the date of his discoveries begins the epoch of the stimulus which has led to the present enormous development of the iron trade. Bars had been always hammered before this to the required sizes, but Mr. Cort introduced the application of rollers, the importance of which we can now fully appreciate; great as were the discoveries of Mr. Cort, he never received any benefit from them. The story of his wrongs is well known. Government seized upon his works at Gosport, sold them, prevented his carrying out his inventions; and in restitution of this great injustice gave his widow a small annuity, and now gives his only son, who is far advanced in years, the trifling sum of £50 a year, after having spent the greater portion of his life in seeking for redress. The coke refinery was also discovered about this time (1810), and the development of the manufacture advanced exceedingly. It is related, in a work on the Turkish empire, that an Armenian of Constantinople had discovered the art of casting iron which, when it came out of the mould, was as malleable as hammered iron; some of the productions were shown to M. de Gaffron, Prussian charge d'affaires at Constantinople; he was struck with the importance of the discovery, and instituted enquiries for the inventor, but he had died poor and unrequited, and his secret perished with him. Many valuable discoveries have undoubtedly been lost to the world in a similar manner, and probably as many by the obstinacy and prejudice of the learned as the ignorance of the unskilful.

(*To be continued.*)

ASTRONOMY.

Some important steps have been gained and some real contributions made to exact science during the past year in the department of Meteoric Astronomy. A summary of these by A. S. Herschel, Esq., formed the next important communication made to the Royal Astronomical Society. As regards the height of shooting stars it appears from a comparison of several hundred observations dating from the end of the last century, that it may be stated respectively at 72 and 52 miles at first appearance and disappearance above the surface of the earth, with a probable error of not more than three miles. The average velocity of shooting stars in sixty-six instances is 35 miles per second. In this respect fire-balls resemble shooting stars, but they differ from them in penetrating more deeply into the atmosphere; should they arrive within 20 miles of the earth's surface a violent concussion is usually produced, and stones are not unfrequently precipitated from the meteor. One of the most remarkable observations of a fireball on record was made by Dr. Schmidt, at Athens, on the morning of the 19th of October, 1863. A fireball of surpassing size and brilliancy was examined for 14 seconds by Dr. Schmidt, in a telescope with a magnifying power of eight diameters. The meteor was twin or double, attended and followed by a tribe of lesser meteors advancing side by side together, with parallel motions of translation, until the whole were extinguished. Respecting the origin of aerolites, it has been found from a microscopic examination of the mixed minerals of which they consist, that these crystals differ in some essential particulars from those of ordinary volcanic rocks, but their consolidation must have taken place from fusion in masses of mountain size. The planetary velocity (at least 15 miles per second) of the meteor, which produced the recent aerolites of Orgueil, greatly exceeds the ballastic forces which can be supposed to reside on the surface of the earth or moon. We are therefore compelled to give a wider range to conjecture with regard to aerolites, and to suppose that they are projected from small planets near and within the orbit of the earth. Aerolites commonly fall in the daytime. They circulate round the sun in such countless numbers, or else they bear such close a relationship to the earth that they in all probability strike the earth daily in its path.

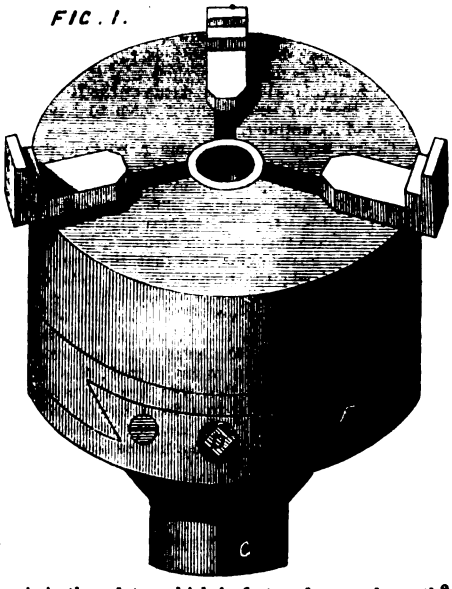
Raising Sunken Vessels.—We mentioned some time ago a collision which occurred in the port of La Joliette, Marseilles, and in consequence of which a lighter, laden with 275 tons of coal, was sunk. This vessel and its cargo have been recovered by the aid of the narval, an apparatus invented by M. Eyber, a civil engineer, and which consists simply of a vast air-chamber, affording through its buoyancy purchase enough to admit of its raising enormous weights.—*Galignani.*

The use of nitro-glycerine for blasting purposes is proposed. It is said to offer many advantages over the old method.

AMERICAN LATHE CHUCK.

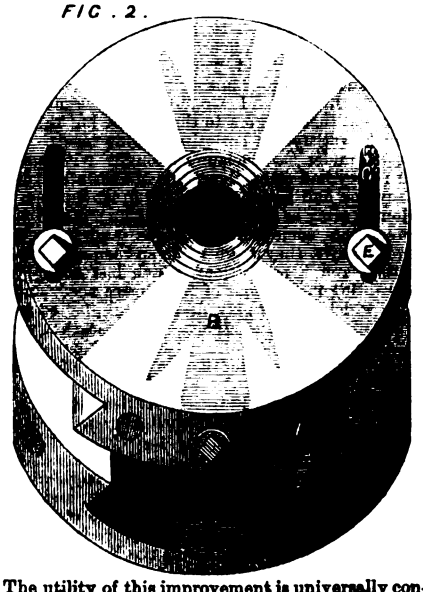
This modification in the chuck for lathes, says the *Scientific American*, is intended to facilitate setting irregular forms, such as eccentrics or cams, and it is to be applied particularly to scroll chucks, which are arbitrary in their motions and cannot be set out of the centre unless one of the jaws be taken out and started on the thread after the other jaws have been run in one turn or two. Even this will not always bring the work true, and some simple arrangement of the kind here shown will prove a great convenience. The details are as follows:—

FIG. 1.



A is the plate, which is fastened securely to the main chuck, forming a part thereof, into which the dovetail projection of the plate, B, slides; C is the hub, which screws on the lathe spindle; D is the screw, by the use of which the chuck may be adjusted to any required position with the spindle of the lathe. The face side of the dovetail projection is laid off to fractional parts of an inch, and marked with figures, so that there is no difficulty in setting the work accurately. The screws, I, hold the piece to which the screw, C, is secured firmly to the plate, B. F is the gib, which is tightened up as it wears, by screws, as usual. G G (Fig. 2), are slots through which bolts, E, pass, for the purpose of firmly securing plate, B, to the chuck, A, at any desired point.

FIG. 2.



The utility of this improvement is universally conceded by all first-class machinists who have seen it, and the proprietors of several of the largest and best machine shops have already expressed a wish to adopt it in their own workshops. This attachment may be applied to any size or kind of chuck already in use, equally as well as to new ones, and will add only from one to one and a half inches to the depth the entire chuck, including the attachment. Though only one sliding plate is represented in the engraving, says the inventor, another slide can be added if necessary. The inventor and patentee is W. Haskell King, 561, River-street, Troy, New York.

PRACTICAL RESULTS OBTAINED FROM BLAST FURNACES BY THE USE OF HOT BLAST OF HIGH TEMPERATURE.*

It is not proposed to enter fully into the history of the numerous attempts which have been made to raise the blast for blast furnaces to a very high temperature, nor will the author occupy much time in the description of the means by which the desired result has been obtained, as a full account of the apparatus was given at the meeting of this association held at Oxford, though the paper on the subject was not printed in the Transactions.

In 1861 experimental stoves only, on the new plan, had been erected and worked for heating the blast for one tuyere out of the five used for one blast furnace. Such satisfactory results were, however, obtained, that it was clear that the difficulty of procuring blast of very high temperature had been overcome, and Messrs. Cochrane and Co., of Woodside Ironworks, Dudley, and Ormesby Ironworks, near Middlesbro'-on-Tees, forthwith erected large stores on the new plan for a complete blast furnace, and it is now proposed, with your permission, to lay before the section the results obtained during upwards of four years' practical working with these stoves.

The effect of heating air on the new plan was that a temperature of blast of 1,150 deg. Fah. was obtained, instead of only 600 or 700 deg., as with cast-iron pipes in the common stoves; there was no loss of blast from leakage, owing to cracked or damaged cast-iron pipes; the iron produced was of rather better quality; twenty per cent. more iron was made from the same furnace, and fully 5 cwt. of coke was saved in the blast furnace per ton of iron made.

The details of the construction of the new stoves will be readily understood by all who have studied the subject.

1stly. There are two stoves, which are heated alternately, and used alternately in heating the cold air; these are filled with brickwork "set open," or with small spaces between the bricks, and form "regenerators," on the principle of Mr. Siemens' "regenerator furnaces," as now so largely and successfully used in glass houses, gas works, ironworks, &c., &c., both for obtaining great heat and economising fuel.

The outside of the stoves are of thin wrought iron plate lined with firebrick, the iron skin being necessary to retain the blast under pressure, while the firebrick resists the heat.

2ndly. There are provided for the purpose of heating the stoves, valves for the admission of gas and air into a central flue, where combustion takes place when a stove is being heated, the products of combustion passing up the flue, and down through the mass of firebricks forming the regenerator, and escaping at the bottom to the chimney, after the whole of the heat has been abstracted by the firebricks; the temperature of the chimney being from 212 degrees to 250 degrees, or thereabouts, during the time a stove is being heated, viz., for a period of four hours.

Then, when a stove is hot, the gas and air are turned off, the chimney valve shut, and the cold blast is turned on at the bottom of the regenerator, and passes up through the bottom courses of brickwork in the regenerator, thus very quickly becoming heated; and passing in the heated state up through the remaining courses of the brickwork, and down the central flue, through the hot blast valve to the blast furnace; the process of absorption of heat by the air being so perfect that, as long as a few of the top courses of brickwork remain hot, the blast is well heated, the variation in the temperature of the blast being only about 100 degrees Fah., with four hour changes.

3rdly. The gas for heating the stoves is supplied from gas producers, similar to those commonly used by Mr. Siemens for his regenerator furnaces, and which have already been described before this Association. They consist of a simple brick enclosure or fireplace, with bars near the bottom, for the admission of a very small quantity of air. The gas is formed by the slow combustion of a very thick fire, supplied with poor coal, or slack down a slope or hopper, the gas passing off from above the fuel through pipes to the hot blast stoves. Gas may,

* By E. A. Cowper.

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however, be taken from the top of the blast furnace for heating the stoves, provided proper arrangements are made to separate it from the dust which comes over from the blast furnace with it; and judging from recent practical experiments, it is certain that there are several ways in which this may be done with perfect success.

The late Mr. James Beaumont Neilson, who did so very much for the iron manufacture by his original invention of the hot blast, in 1829, was sufficiently longsighted to predict the advantages that would flow from the use of blast of very high temperature, though, as it happened, he was limited to what could be obtained from passing the air through iron pipes exposed to a fire, as in common stoves.

Mr. Neilson said:—"In the new regenerator ovens that had just been described the great capacity of firebrick for heat had been well taken advantage of, and a very important step in advance had been made by giving the means of raising the temperature of blast much above the extreme limit practicable with the old ovens; and he considered this would be productive of the greatest benefit in the working of the blast furnace. . . . He had no doubt the make of iron would be considerably increased by the higher temperature of blast given by the regenerator ovens."

These anticipations have been fully borne out in practice during upwards of four years' regular working of the stoves. The high temperature of the blast produces such an improved effect in the furnace that the "burden" is increased so as to save fully five hundredweight of coke per ton of iron made; and as there is less fuel supplied, so there are less impurities taken in, and the quality of the iron is improved, the "tuyere-breasts" do not "work hot," or burn, or give more trouble than usual, as the burden is increased as just stated. The same furnace is, of course, enabled to do more work, the "make" being increased fully one-fifth; so that a given plant produces 20 per cent. more iron per annum, besides saving nearly 3s. per ton for coke.

There is less friction or loss of pressure of blast in the stoves than in common ones, and there is no loss of blast by leakage through cracked or burnt cast iron pipes or joints. More stoves are now being erected on the same plan.

GENERAL NOTES.

IT is proposed to hold another exhibition of the works of the industrial classes of both town and country during next year at the Agricultural Hall, Islington. The special features of the exhibition will be the encouragement of skilled workmanship, amateur productions, facilities for the sale of articles, machinery in motion, musical gatherings, lectures on popular subjects, manufacturing process in operation, flower shows, conversazione of masters and workmen, free admission of school, free reading-room, prizes for evergreens, &c., in pots and a small garden.

GALE'S PROTECTED GUNPOWDER IN AMERICA.—Mr. Handel Cossham, who left England a short time since with Sir Morton Peto and other English capitalists for a visit to the United States, has there introduced Gale's process for protecting gunpowder with the same success as has attended the experiments in England. The New York papers publish the particulars of an interesting series of experiments tried at the Jersey City Locomotive Works, for testing the process, which were very satisfactory.

DRILLING ROCKS.—A machine has been invented by Mr. Robert Hood, of Drayton, Ohio, which consists in the employment of a spiral lifter, in combination with a tappit extending from a sleeve fitted in the drill or drill-rod, and with an arm extending from said sleeve in the cam slot, in such a manner that, by the action of the cam slot or arm, the tappit is held in contact with the thread of the feeder until it arrives at the end of the stroke, when the same, by a curve in the cam slot, is thrown out of contact with the feed-screw, and the drill is allowed to drop, and, while being thrown out of gear with the feed-screw, it is turned, causing it to strike a different spot on each stroke. By this arrangement two or more drills can be operated by means of the same lifter and by the same driving power.

Mr. SMYTH stated that we dig annually 84 millions of tons of coal from our pits. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night, with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

THE total production of the collieries of Prussia in 1864, was estimated at 42,394, 500 tons.

IMPROVED PUDDLING-FURNACE.—Mr. J. Williams, Montreal, Canada East, claims—1. the novel arrangement in a puddling-furnace of a blind grate with the ordinary grate, together with the combination of slide-doors, trap-doors, tewed-holes, and air-chamber, whereby for all the fuel consumed in the blind grate the benefit is received into the body of the furnace on the iron, with much less of the fuel passing up the chimney than in the ordinary furnaces. —2. in the different grates he claims the introduction of the trap-doors for letting the ashes, cinders, &c., fall into the external ash-pit, and thus save the handling out of ashes when the furnace is in operation, thereby effecting a saving of time. 3. He claims the peculiar arrangement of water boshes, whereby water may be employed without the danger of an explosion from the generation of steam.

NEW METHOD OF FERTILIZING SOIL.—Two gentlemen, members of the Agricultural Academy attached to the University of Bonn, M. Nouenbruck and Dr. Hardstein, have conceived a new method of assisting the formation of humus, and which, it is said, has been put into successful practice at Annaberg, near Bonn. The method is the introduction of air beneath the surface of the soil; a system of pipes, like those used for drainage, but pierced full of small holes, are laid at depths of from three to six feet beneath the surface of the ground, is placed in connection with a furnace, which keeps up a continual draft through the pipes, and thus the subsoil becomes so impregnated with air, that when the connection with the atmosphere is closed, the fire continues to burn in consequence of the superabundant oxygen which is conveyed to it by the pipes.

ECONOMIC RAILWAYS.—The French Government has recently purchased the free use of a locomotive designed by an engineer named Rarchaert, for the purpose of running on light rails, and passing over sharp curves and steep inclines. M. Rarchaert's engine, with the tender and fuel, does not exceed twenty tons in weight, has four pairs of wheels, coupled, and will not require rails exceeding forty pounds in weight to the metre. The pressure of each wheel would thus be equal to two tons and a half, while that of the locomotives in use on the great lines ranges between five and six and a half tons, and the rails themselves weigh from seventy to eighty pounds per metre. The engine is said to be able to draw 640 tons, in addition to its own weight, on a level, 310 tons up an ascent of 5 in 1,000, and so on, to 74 tons on a gradient of 30 in 1,000; and, at a speed of from eighteen to twenty-four miles an hour, it will, according to the inventor, work safely on curves of a minimum radius of sixty metres; and, therefore, by adopting gradients varying from 12 to 30 in 1,000, nearly all necessity for tunnels, viaducts, and embankments would be avoided. The inventor calculates that under his system the average cost of these local railways will not exceed 60,000f. the kilometre, or less than £4,000 per English mile.

GALACTOZYME.—Galactozyme, or galozyme, is the result of the fermentation of milk by means of yeast, and is used, as stated by Dr. Schnaepff in the *Gazette Hebdomandaire*, by the inhabitants of the Steppes of Russia as a sovereign remedy in phthisis. Cases are mentioned in Dr. Schnaepff's articles where the patients gained considerably in weight by taking half a tumblerful night and morning; but the doses must be regulated by the peculiarities of the patients. Nor is it indifferent whether the fermentation is carried to a greater or less extent.

ACCORDING to Prof. Tyndall 474,439,680,000,000 of waves of light enter the eye in a second of time to produce the impression of red colour. To produce the impression of violet a still greater number of impulses is necessary: it would take 57,500 waves of violet to fill an inch, and the number of shocks required to produce the impression of this colour, amounts to 699 millions per second. The other colours of the spectrum rise gradually in pitch from the red to the violet.

WEBSTER, in his "History of Metals," published in 1671, makes mention of two places in the West Riding of Yorkshire, where formerly good argentiferous lead ore had been procured. One of the places was Bronghite Moor, in the parish of Slainburn; the ore held about the value of 67lb of silver in the ton; the other place was Skelhornfield, in the parish of Gisburn; it had formerly belonged to a person of the name of Pudsey, who is supposed to have coined it, as there were many shillings in that county which the common people called Pudsey shillings.

FURTHER ADVANCE IN THE PRICE OF COPPER.—In consequence of a further advance of £5 per ton in the price of copper, the principal firms yesterday raised the price of brass and copper wire and tubing a halfpenny per lb., and yellow metals a farthing per lb.—*Birmingham Gazette.*

CHEMISTRY.

RESULTS OF THE EXPLOSION OF NITRO GLYCERINE.

The new blasting material is a light-yellow oily fluid, a compound of glycerine and nitric acid, its chemical formula being $C_6H_5O_3(NO_5)^3$, which gives 18 parts of oxygen; and Mr. Nobel claims that as by combustion the carbon takes 12 atoms of oxygen, and the hydrogen 5, its complete combustion leaves a surplus of O_1 only. He states, moreover, that each 100 parts of exploded blasting-oil leaves a residue of —carbonic acid, 58; water, 20; oxygen 3½; and nitrogen, 18½=100; and that as the specfic weight of the oil is 1·6, one volume produces nearly 1300 volumes of gas—that is to say, steam, 554; carbonic acid, 469; oxygen, 39; and nitrogen, 236=1298 volumes. Weight for weight, the blasting-oil bears very favourable comparison with gunpowder, which is calculated to produce ordinarily about 250 volumes of cold gas only; the nitro-glycerine would, consequently, appear to be, other things being equal, about five times as effective as gunpowder. But Mr. Nobel goes further than this, for he remarks that it is difficult to determine the degree of heat produced by an exploding substance, and that, according to theory, the blasting-oil, on account of its complete combustion, ought to develope a more intense heat than gunpowder, and this appears to be borne out by experiment; whence he assumes that the heat developed by the explosion of nitro-glycerine is twice that generated by gunpowder, and from this calculates that nitro-glycerine, compared with gunpowder, possesses about 13 times its power, when volumes are considered, and 8 times its power for equal weight; and that owing to its rapidity of explosion its advantages are still greater.

ACADEMY OF SCIENCES.—OCTOBER 9.

M. de Cizancourt presented a memoir "On the Allotropic Conditions of Iron." The author, like Berzelius, recognises two allotropic states of this metal, and adopts the same names for them—ferrosum and ferricum. Ferrosum is the metal from ores containing protoxide; ferricum is obtained from the anhydrous peroxide ores. The most characteristic form of ferrosum is the white crystalline cast iron (Spiegel Eisen), commonly obtained from the carbonate, and is best produced at a low temperature. This form of iron has a strong affinity for carbon. Chemically it must be classed among the bodies which unite with one atom of oxygen. Ferricum also combines with carbon at high temperatures, but deposits it again on cooling. This form of iron gives the malleable metal, and also blistered iron. The author states that while ferrosum easily passes into ferricum, the inverse change cannot be effected. Ferricum belongs to that class of bodies which combine at least with three atoms of oxygen and often more, but always an uneven number of atoms. This memoir will have considerable interest for metallurgists, and we shall therefore give it at length.

M. Bultinck presented a note "On the Use of Magnesium in Voltaic Piles in Place of Zinc." Our readers can imagine the results. The author shows that a short chain of twenty elements, each composed of thirty-five millimetres of thin silver and magnesium wires, wound about pieces of caoutchouc and properly connected, will produce all the effects, chemical, physical, and physiological, of a long Pulvermacher's chain when simply moistened with pure water.

M. Jennet presented a note "On the Clarification of Peaty Waters by Alum." Most of our readers will have heard of a method of clarifying and rendering portable certain muddy waters by stirring or shaking up with them a very small quantity of finely powdered alum. Then, after standing a few minutes, the suspended impurities deposit, and the water becomes perfectly bright, and at the same time extremely palatable. The explanation of this is as follows:—In dissolving, the alum splits up into sulphate of potash and sulphate of alumina. The former remains in solution in the water; the latter decomposes, and the insoluble alumina unites with and carries down the suspended organic impurities; while the sulphuric acid acts on the alkaline and earthy carbonates, forming sulphates and setting free carbonic acid. The biphosphate of alumina, although slower in its action, the author thinks would be a better clarifier if the carbonic acid set free did not dissolve some of the neutral phosphate. Some persons will, perhaps, see a recommendation in what the author considers an objection.

AT the Birmingham Industrial Exhibition last week, the first prize, of the value of £25, was awarded to Mr. Peter Gaskell, the inventor and patentee of the cab indicator, which shows the distance the cab goes, and the amount the passengers have to pay.

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(From the Commissioners of Patents' Journal.)

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2571. Bricks, V. J. B. Germaix.
2029. Cabs, checking the payments of fares in, H. A. Bonneville.
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2137. Cast steel, &c., manufacture of, R. A. Brooman.
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2329. Fires, apparatus for lighting and reviving of, C. J. Webb.
2615. Gas lamps, J. J. Parkes.
2569. Gun carriages, G. W. Rendel.
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2619. Harness for driving machinery, J. Crutchett.
2445. Hydraulic pressure engines, J. Dreisorner.
2555. Injection to the human body, administering, W. R. Barker.
2461. Iron and steel, manufacture of, T. E. Cashin and J. F. Allender
2357. Leather, L. G. Sourzac and L. Bombail.
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2597. Mangling and callendering, R. Walmsley.
2613. Measuring, rules for, A. Nicholls.
1555. Metallic stuffing box, V. Duterne.
2547. Nap or pile of nap or pile fabrics, cutting or shearing the, W. B. Stocks, J. Whitwham, and W. Blakey.
2607. Pianofortes, G. G. Rich.
2621. Railway carriages and locomotives, M. Henry.
581. Railway carriages, &c., construction of, H. G. Craig.
2567. Rotary engines and pumps, R. A. Brooman.
2599. Scent and smelling bottles, T. Miles.
2551. Sewing machines, M. Henry.
2313. Sewing machines, wheel feed for, J. Hose.
2397. Spoons, forks, &c., D. J. Fleetwood.
2483. Sulphurous acid, obtaining, R. Reece.
2609. Ventilating apparatus, J. G. Woodward.
2601. Vessels, propelling, W. Clark.
2485. Wheat, &c., grinding, B. Wren.
2577. Wooden spills, T. Machin.
2039. Wool, &c., washing, J. Petrie, jun.
2573. Writing, pens used for, R. M. and D. Cameron.
2593. Wrought iron girders, J. Homan.

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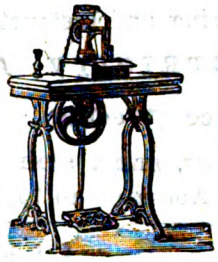

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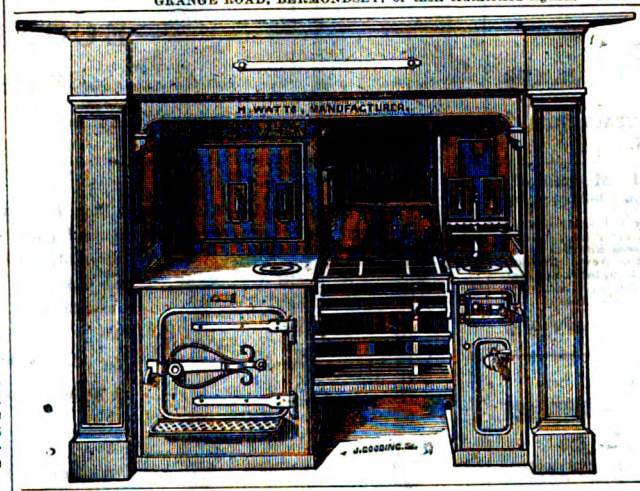

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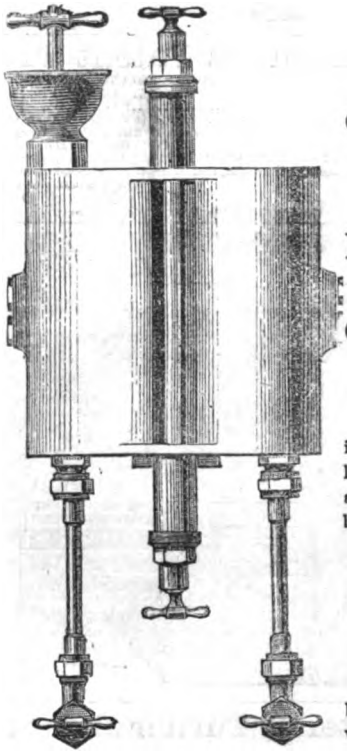

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THE

ENGLISH MECHANIC:

A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

VOL. II.—No. 33.] FRIDAY, NOVEMBER 10, 1865. [PRICE ONE PENNY.

COOLING AND FREEZING.

OUR readers have at various times asked us for an illustration of the machinery used for these purposes. We have now the pleasure of complying with their wishes. The apparatus is styled "Brooman's Cooler and Freezer," and is founded on a communication to him from Marcar Beylih'g, of Constantinople. The apparatus, which the inventor denominates "psychrogene," produces artificial cold by the vaporization of a volatile fluid, the same quantity of which may be used over and over again. The congealing receiver partakes of two special forms dependent upon the ice to be produced.

The accompanying illustrations shew the combination of parts constituting this new apparatus.

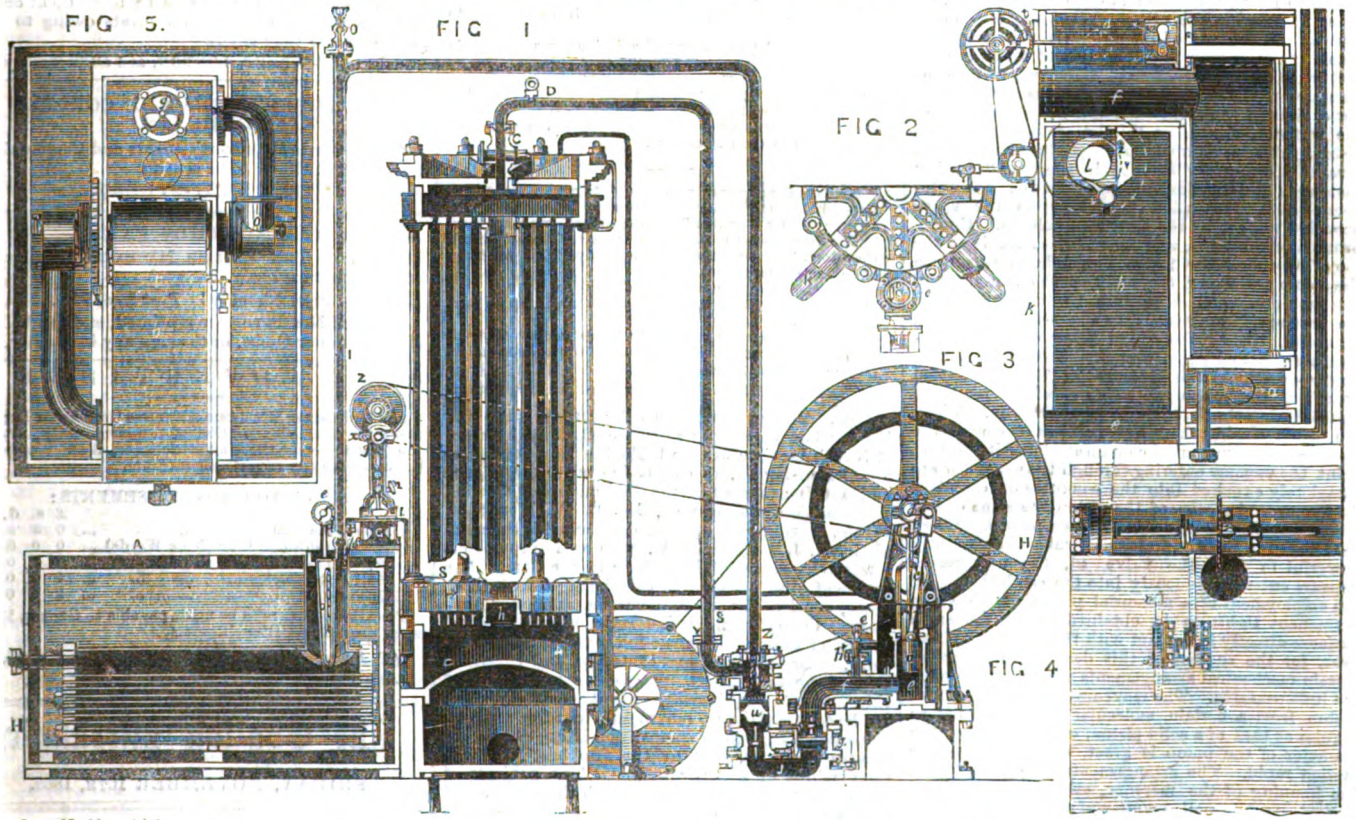

Figure 1 is a vertical section of the whole apparatus; Figure 2 is a plan of the condenser; Figures 3, 4, and 5 shew in elevation and plan the congealing receiver.

a is a piston, the working surface of which is hermetically closed by the leather *b*; the connecting rod *c* is united to the crank *d*; *e* is the cylinder fixed upon the base of the water reservoir e^{11}; one end of the bent tube *f* is fitted to the side of this cylinder, while the other end is united to the cylindrical piece *g* of large diameter; the bent tube is provided with a safety valve *b*, the orifice of which opens in the water reservoir. The cylindrical piece *g* is screwed upon the opening *i* of the mercury piston *j*, leaving at the point of junction circular cavities h^{11}, h^{11}, the section of which is in the form ⋊. The cylinder *g* receives the moveable cover *l*, the rod of which slides in a ring. The conical opening *m* of the mercury well receives the body of a valve *u*, opening upwards, and guided by a vertical rod. Upon the opening *m* of the mercury well a compartment *o* is fixed, where the valve *u* slides with very slight friction; at the upper part of this compartment there is a cup *p*, in the centre of which there is a bi-conical opening for receiving on one side the valve *u*, and on the other the body of the valve *q*, which is pressed by a coiled spring. The cup *p* is pierced laterally with a circular opening, in which a solid piece of glass *r* is hermetically fixed. *s* is the pressure chamber; to its upper part a cylindrical tube is screwed, and at its lower part, which is conical, rests the suction valve *u*, which is in the centre of the valve *q*, and in this manner the orifice of this latter is in communication with the compartment *o*. The pressure chamber *s* terminates laterally in a tubular branch *t*, covered by a second valve without spring u^1; *v* is a pipe uniting the ejection chambers; and *z* is a pipe uniting the suction compartments. A is the receiver of the condenser, surmounted by a series of a tinned iron tubes surrounded with fine cambric, the rows of stitches of which are folded in loose nets; the upper ends of these nets traverse caoutchouc tubes, which dip in the reservoir B; it is furnished with a cock C, from whence runs the conducting pipe D, which places the interior of the condenser in communication with the pressure chamber. The box e^{111}, annexed to the condensation receiver, encloses a bath with a thermometer filled with alcohol, and is pierced with two openings f^{11} and g^{11}, the one of which receives the discharge tube h^{111}, communicating with the inside of the feed cock (see Fig. 1), and the other communicates with a pressure gauge marking twelve atmospheres; there is also a level gauge i^1 fitted to the box e^{111}. J is a fan chamber open, upon the plan of a centrifugal fan; *k*, *k*, are the blast pipes, the arrows in which indicate the direction of the current; E is a tubular steam boiler, in the dome F of which the steam generated is stored. In the centre and upper part of this dome a bath with a thermometer c^1, filled with alcohol, is suspended to free the vapour of any drops of liquid carried off mechanically. The opening d^1 is for receiving the body of a vacuum and pressure gauge e^1 marking up to 12 atmospheres; f^1 is an opening, which is carried through the tube g^1 in the bottom of the boiler, and in communication with the discharge opening of the feed cock; h^1 is the body of a cock on which the suction pipe I is fixed, and through which the pumps take their supply; j^1 is the level indicator gauge; G is the vertical section of the feed cock, the base of which l^1 is pierced with two bent conduits, into which the ends of the tubes *g* and m^1 are introduced laterally. The upper orifices of the bent conduits are covered with sheet lead, which is soldered to the base l^1 and *y* pressed by the cylindrical piece o^1. Upon it rests the pointed end of a forked bar p^1, the arm of a lever q^1 charged with a weight r^1, resting upon the forked bar, the cylindrical piece o^1 presses the sheet of lead upon the base l^1 so as to close communication between the tubes g^1 and m^1; the ring s^1, moveable upon its screw thread at the end of the lever, is traversed by a rod t^1, furnished at bottom with a button u^{11}, and joined at top to the carriage v^1, which is free to slide or to remain fixed by a screw upon the crank x^1 when the shaft of the toothed wheels receives its

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motion from the fly wheel shaft through a belt and the pulley Z^1, the rod t^1; moved by the crank, slides in the ring s^1, but when the button abuts against the end of the lever arm q^1, it rises to travel with the rod, and ceases to press the cylindrical piece o^1 against the sheet of lead; the elasticity of this latter yielding to the power of the compressed vapours, moves from the base upon which it was applied by the action of the lever, the small valve opens, whereupon communication takes place between the two lateral conduits; the play of the cylindrical piece o^1 being limited in the space in which it is placed, the sheet of lead can only move a very slight distance from the base. When the crank reaches the position in which it no longer supports the lever, the sheet of lead compressed by the existing power becomes again placed upon the base, and passage by the cock is immediately shut off; by changing the position of the button n^{11} upon the rod, and of the carriage r^1 upon the crank, the duration of the action of the cock may be varied at will. Among the outside parts shewn in the drawings there is the fly wheel H and the fan J, which drives the air through pipes K, K, around the pipes T of the condenser A; H^1 is the framing which encloses the generator and congelation receiver N.

To explain the action of the apparatus: the mercury well j, the compartment o are filled with fine mercury, the maximum level of the mercury is designated by + upon the cup p, and the lowest level in the cylinder g by —, the piston a is driven into the water, whereby the interior of the pump is entirely filled to the exclusion of a single air bubble. To follow the working of the apparatus it will suffice to follow the action in one of the pumps, all being identical in the other. When the piston a at first at the bottom of its stroke is raised by the crank, it draws after it the column of water in contact with it. The column of mercury forms a continuation to the column of water, sinks in the chamber o, rises in the cylinder g, and takes the place of the water displaced, as this latter does that of the piston. A vacuum tends to be produced above the level of the mercury lowered in the chamber o, but thereupon the tension exercised in the generator opens the suction valve u, and enters the space occupied at first by the mercurial column. Equilibrium is established, and when the crank is at the top of its course the piston descends, presses upon the column of water, the water on the mercury and this latter compresses in turn the vapours, which are prevented returning into the chamber of the generator, the suction valve being closed. It becomes more and more compressed until its elastic power overcomes the pressure in the compression chamber, and raises the valve q, which remained closed during the first course of the piston. When the piston reaches the lowest point of its course, the elevation of the mercurial column attaining its highest point, the vapours entering through the generator are completely expelled into the compression chamber. At the second stroke of the piston the same effects are produced, and so on in the two pumps. When the tension in the compression chamber is sufficiently powerful to raise the valve u^1, the compressed vapours enter continuously into the condenser. By the employment of a mercurial piston absolute and permanent tightness is obtained in the moveable surfaces directly in contact with the vapours. However, for the success of this description of pump certain mechanical arrangements which will be cited are indispensable. The movement of the mercurial piston from a certain molecular motion is not so regular as that of a solid piston, especially when the diameter of the pump is great, and the to-and-fro motion rapid. The arrangements adopted prevent the jumping of the mercury, and control its level every instant a small quantity of mercury penetrates into the cavity n, and tends to destroy any injurious space. The object of the circular cavities h^{11}, h^{11}, is to prevent the water passing by sliding upon the slides of the cylinder g.

[We are sorry that lack of space compels us to delay the remainder of the explanation till our next number.]

TIDES are affected by the state of the atmosphere. At Brest the height of high water varies inversely as the height of the barometer, and rises more than eight inches for a fall of half an inch of the barometer. At Liverpool a fall of one-tenth of an inch of the barometer corresponds to a rise of the Mersey of about an inch; and at the London Docks a fall of one-tenth of an inch corresponds to a rise in the Thames of about seven-tenths of an inch.

HERODOTUS refers to a petroleum spring at Zante, and it is said that the oil was used for burning at Agrigentum in Sicily.

ANSWERS TO CORRESPONDENTS

SPIRITUAL MECHANICS.—Two letters are lying at our office for the enquirer in this matter. They will be forwarded to him when address received.

J. M. S.—Your letter having reached us (from the publisher) mutilated, will you kindly forward us another for insertion.

C. LUCCHURST.—Thanks for your letter. The one inserted covers your ground.

GEORGE JOHNSTON (Ashley).—If you send to Mr. Woodcroft, at the Patent Office, he will forward you the specification at its price.

JOHN PALMER.—We don't think Lloyd's will insure under the circumstances. It is understood that officers generally are certificated; in fact, we believe they must be, to comply with the particulars of insurance.

J. D. E.—Thanks for your letter. You have been anticipated, and satisfactorily. Your query in another column.

JOSEPH HAGUE.—Send a stamp and your address to Weale, Holborn; Lockwood, Stationer's Hall Court; and Spon, Bucklersbury, and they will forward you their catalogues. You will find it in one of them, we think.

A NOTTINGHAM MECHANIC.—Thanks for your letter. What has been given has been asked for by very many. What you require will shortly be started again. There is an Elliott in 475, Oxford street; you might send there, but we don't know of the book you mention.

J. W. W.—Send to Spon's, Bucklersbury.

E. ADAMSON.—It would meet with a certain amount of sale, provided you were in business, and had the means of pushing its sale along with other things. In that case, it would be worth while patenting. We question if it would under any other circumstances be worth more than trying a "provisional protection," and endeavouring to sell your right.

J. L. HAMPTON.—Tredgold's is a capital work; also Fairbairn, on millwork. Send to Spon's, Bucklersbury.

J. H. W. G.—We will endeavour to get what you want.

S. F. FURNER (Paisley).—A humbug. Have nothing to do with it.

FRED HARDY.—An engraving of a design for a velocipede will appear in our columns next week.

R. B. W.—Thanks for the trouble you have taken.

PHILANTROPOS.—Thanks; the hint will be borne in mind.

AGATE.—1. We will enquire for you. 2. We had often been asked for the memoir, and it appears to give great satisfaction to our subscribers.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts as the Editor cannot undertake to return such as may be rejected.

ROYAL SCHOOL OF NAVAL ARCHITECTURE.—On Monday last the winter session of the Royal School of Naval Architecture and Marine Engineering at South Kensington, in connection with the science and Art Department of the Committee of Council on Education, was opened, Mr. C. W. Merrifield, F.R.S., having been appointed principal in the room of Mr. H. J. Purkiss, B.A., who was drowned a few weeks since while bathing in the Cam. The course of study, which is calculated to last three years, consists of pure mathematics, applied mathematics, theory of fluid and resistance of waves, theory of design, construction and behaviour of ships, theory of steam and of design, and construction of steam engines, practical construction of ships, naval equipment, naval artillery, &c. In the course of the present month, four free studentships will be given in competition if qualified candidates come up, and to the two best of these scholarships of £50 per annum. The subjects of the competitive examination, with the number of marks attached to each, will be as follows:—1. Pure mathematics, including arithmetic, geometry, plain and descriptive; trigonometry, and the elements of the differential and integral calculus, 2,500 marks; 2. Theoretical mechanics or applied mechanics, 1,000 marks (in these subjects at least half the marks will be required); 3. Practical mechanics, 750 marks; 4 Practical shipbuilding; 5. Steam; 6. Physics; 7 Chemistry; 8. Mechanical and freehand drawing, 750 marks.

SOUTH-EASTERN INDUSTRIAL EXHIBITION.—This exhibition, which opened on Saturday week at Greenwich Hospital, has since been visited by an average number of 1,400 persons daily, and promises to be entirely successful. It is our intention to publish an extended notice of the mechanical department, in a future number of THE ENGLISH MECHANIC.

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NOTICE TO ADVERTISERS.

ADVERTISERS in this journal are respectfully informed that the Collector from the office, 162, Fleet-street, will call upon them for a settlement of the amounts due for the insertion of advertisements. The Collector will in every instance hand in a printed receipt for the sum paid to him. Advertisers are particularly cautioned against paying money without receiving the printed receipt.

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All Advertisements should be sent to us not later than Friday.

The English Mechanic.

FRIDAY, NOVEMBER 10TH, 1865.

FILE CUTTING BY MACHINERY.

IT is not so very long since we were informed that hand-cut files would soon sell at high prices—for museums, and as curiosities; for that the file-cutting machine was about to take the trade upon itself, and convert file-cutters into workhouse tenants, or other sort of cast-off clothes. We demurred to the statement at the time, knowing that the machine, as at present constructed—rocker bed and all—could not do the best quality of work, and in many cases could not do it at a figure lower than that now paid to the hand worker. We have waited for the file that was to be equal to the old hand-made one, but have not yet seen it; and the feeling is rapidly coming over us that the file-making machine companies of Manchester and Birmingham are more anxious now to sell their machines than they are to make files. About the time of the starting of these companies a bad name was given to the Sheffield men—before the trial of the machines be it remembered,—that they

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would blow up the factories, assault the men who worked therein, and generally throw a sufficiency of obstacles in the way of the work as to render it anything but profitable. Whether this "name" was put on the "dog" by those interested in getting up the companies, we know not—we hope not; but the name was given, and the coincidence is singular, and suspicious. Now as to the men not allowing the machine to work: thirty years ago Messrs. Turton and Sons—a well known name and brand, by the way—erected file-cutting machines at their works in Spring-street, Sheffield, and the men did not strike against it, but did the work the machine could not do; nor have they ever, so far as we are aware, done more against the machine than this. Eventually Messrs. Turton's machine was turned on to the scrap heap, as the best place for it. So much for the interference of the men, and the efficiency of the machine. Now, as to difference in cost of production. Referring to the prospectuses of these companies, it is stated that good file cutters earn from £3 up to £5 per week. What is the fact? The "flat bastard file—14 inches" is the leading article in the trade, and for these the workmen are now better paid than ever they were. These "bastards" are now paid 3s. 6d. per "dozen of thirteen,' for cutting, and he is no ordinary workman who can turn out seven dozen a week—year's end to year's end. Now from these four-and-twenty shillings two have to be deducted for steel and lead, and repairing chisels, leaving the workman twenty-two shillings as against the £3 to £5! Were the workman to be paid at this latter rate their would be a fine chance, and a necessity, for the machine—if it could produce all the workman can, which it cannot. We should like very much to know what it does cost to produce files, of any name, by machinery, including wear and tear, and all the odds and ends of necessary items; and until we can get at this we cannot make the comparison complete. Further than by this—that manufacturers seem disinclined to laying down the new machinery—not, be it remembered, from fear of the handworkers, but having a wholesome dread of having to do as did the Messrs. Turton and Sons.

It is just possible we may be wrong—only, by our present light, we don't think so. If any reliable figures, confirmed by actual experience, can be forwarded us, we shall be happy to give them the consideration and publicity they may deserve. J.F.H.

HOW TO CONSTRUCT AN ACHROMATIC ASTRONOMICAL TELESCOPE.

SIR,—The invention of the telescope and the microscope may be properly classed amongst the most important discoveries ever made. True, the steam-engine has done more for the social well-being of mankind; but no inventions have done so much to ennoble the mind with exalted views of the Creator of all things. By the aid of one, we find the most perfect organisations existing in the minutest form, invisible to the naked eye; the other reveals to us the infinite extent of creation, in the innumerable worlds existing throughout the immensity of space, and opens to our view wonder, beauty, and grandeur, of which we should otherwise remain ignorant.

The possession of a good telescope is a source of unspeakable pleasure of the purest and most intellectual character, and this my humble effort at endeavouring to popularise this noble instrument, is one of the most pleasing—knowing it to be an object worthy of any man's ambition; and ere I lay down my pen, I trust I shall have placed the possession of a telescope that will show Saturn's ring within the reach of even a working man's pocket.

I will now briefly describe the construction of a telescope of a power of 120—a power which will show the half-enlightened phase of Venus, the satellites of Jupiter, the rings and two or three of the moons of Saturn, the nebulæ in Orion, the companion to the Pole Star, the components of most of the double stars, and also divide the quadruple star in Lyra, together with various other phenomena of equal interest. Its cost, if my directions are strictly attended to, will not exceed £2 10s., which is but very small compared to the price of one of the same power, if made by an optician, viz., £9.

The first thing required will be the lenses, which can only be obtained from Mr. J. T. Slugg, 214, Stretford-road, Manchester, a gentleman who has devoted the greater part of his life to the construction of *cheap* and *perfect* achromatic lenses; and a gentleman to whom the public I think are greatly indebted for his unceasing efforts to popularise the telescope by placing it within the reach of all classes. The object glass must be 2⅜ inches diameter, and 36 inches focal length, and will cost £1 5s. The eye-piece is a *pancratic* one, and contains three powers, viz., 80, 100, 120, and costs 12s. Both lenses are fitted into cells ready to be inserted into the tubes, and it is advisable not to remove them from their cells on account of their liability to get scratched. These will be carefully packed and forwarded to you on receipt of a Post-office order for £1 17s., payable to Mr. J. T. Slugg. You must next procure two tubes of brass or other suitable metal, which can be obtained at a small cost from any respectable ironmonger. One of these must be 31 inches long, and the diameter suitable to your *object-glass* or the larger lens, which has to be inserted. Before fixing in the *object-glass*, care must be taken to blacken the inside of the tube by a mixture of lamp-black and spirits of turpentine to prevent reflection.

The other tube must be 10 inches long and of a diameter suitable to your *eye-piece*. This must be blackened in a similar manner to the large tube, and after it is dry the *eye-piece* is to be fixed in the one end.

You have now the two parts of your telescope, and all that is required to complete it is to place them together in the following manner:—

Make a block of wood three inches long, and of a diameter *tightly* fitting the open end of your large tube; in the centre of this block you must make a hole in which your small tube will slide backwards and forwards, but not too easily. This should be turned in a lathe, and without you possess one, you should get a carpenter to make it for you, as *the centre of the eye-piece must be in a direct line with the centre of the object-glass;* and the smallest deviation in this respect will materially injure the working of your telescope. This block should also be blackened.

For a telescope this size it is necessary to have a stand which is very firm and steady, and I should advise my readers to obtain one direct from Mr. Slugg, who makes an excellent one suitable for the above telescope at 16s. 6d., for a home-made stand is at best but an unsteady affair.

This telescope is one which, as regards power, I strongly advise my readers to be content with, if they make it themselves, as although for a few shillings more you can have more powerful lenses, yet the difficulty of constructing them properly increases so much, that it is time and labour lost. And I am sure the most interesting views can be obtained with this telescope. Indeed, some of the most important discoveries have been made with telescopes of comparatively low power.

Although this instrument cannot be supposed to possess that exquisite finish and expensive workmanship which is required by the *professional* astronomer in making his observations, it will nevertheless be so exact and well made as that it shall give to the man who may possess an intelligent and enquiring mind, but limited means, "an opportunity of making himself practically acquainted with those wonders of the starry heavens revealed only by a telescope, which he would, perhaps, live and die without ever seeing, but for such an opportunity.

Once you have made your telescope you will find ample repayment by the glorious views it will reveal to you. I could and would willingly say more on this interesting subject, but space bids me conclude, and I fear I have already taken up too much space in our valuable journal, THE ENGLISH MECHANIC. But I trust that this short letter may be the means of inducing some of your readers to profitably employ a few spare hours in the study of this most interesting and inspiring science; and I feel they will soon enter into the feeling of the Psalmist in saying, "The heavens declare the glory of God, and the firmament showeth His handiwork."

6, Old Jewry, London, E.C. R. B. WEGG.

P.S.—Should any reader require any further instructions I shall be most happy to communicate with him.

CHANCELL, an English captain, in 1554, first sailed into the White Sea, and this led to the building of Archangel and the commerce of Russia.

DR. BENCE JONES states that sugar is produced in fluids of the animal body by extreme cold, owing to deficient oxidation of the carbonaceous articles of food.

M. BUNSEN finds that pyrolusite exceeds bismuth in thermo-electric power, and copper pyrites possess the same quality in a still higher degree.

M. REGNAULT has succeeded in obtaining photographs with bromide, iodide, and fluoride of copper; the bromide proved the most sensitive.

MR. BOEHM states that the misletoe has precisely the same relation to its nutritive plant as a twig to its parent branch, or a graft to the stock.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

ELECTRO-MOTIVE POWER.

Sir,—It appears to me that there is an immense mechanical motive power lying dormant in Electro Magnetism. We all know how great is the lifting power of an electro-magnet, even when influenced by a very small battery and weak current.

With this fact in view, wherein lies the difficulty of propelling ships by means of electro-magnetism, except the cost of battery power? I suggest whether it would not be practicable to convert the ship herself into a galvanic battery by sheathing one side with copper and the other with zinc, insulating the sheathing from the ship by means of sheets of gutta percha. The galvanic action of salt water on so large a surface would generate a sufficient electricity to create very large electro-magnets of immense power. Two thick wires or rods carried through the sides of the vessel in contact with the copper and zinc would communicate with the electro-magnetic engine, of which there are various forms. I suggest two very large magnets laid horizontally with their poles opposite each other, with an armature attached to a crank working between them; the current would be charged at the instant of contact, and the engine would be adapted to drive a screw shaft. The battery power would of course increase in proportion to the size of the ship. Perhaps some of your readers may be able to turn my suggest on to account. It is simply a question whether sufficient power can be obtained from the action of salt water on so large a surface as the whole area of immersion of a floating vessel. From minor experiments I have not the least doubt of it myself. JNO. TAWSE.

STEAM BOILER.

Sir,—In your number of November 3rd, Aspirant offers several objections to my boiler. He asserts that the boiler would be a very heavy one, and that the plan would only add strength to the weakest parts. The only increase of weight will be the hoops, and the increase of their weight will be but of little consequence. Strengthening the weakest parts is a great desideratum.

The fallacy in the next paragraph of his letter is mainly caused through my own neglect at not stating in my letter to your journal, that the design was intended for a boiler fired internally—in which case, I intended that the flues should be made on the same principle reversed, when the steel traps will be dispensed with and the thickness of the two plates of iron will be nearly equivalent in their superficial area and thickness as the ordinary lapjoints. The plates can be made in size according to the power of the boiler, and judgment of the maker; but he will perceive that the greater the number of hoops the stronger will be the boiler. I prefer the four plates in place of one, as he suggests on account of the liability of having a defective plat if rolled entire. I have no objection to welded joints in boilers, except that rivetted joints are more reliable; for the risk of imperfect welding is greater than that of imperfect rivetting. ADRIAN NEISON.

OUR SUBSCRIBERS' NOTES AND QUERIES.

ASSAYING.—Would any reader inform me respecting the title and approximate value of a good book, treating upon assays of copper, silver, and lead mineral, wherein the method of assaying is clearly explained.—H. E.

ZINC TRAY.—What would be the cost of a zinc tray, 2ft long, 1ft. broad, 4in. deep, painted, with an ornamental wire rail 8in. high, round top—designed for an uncovered fernery.—J. D. E.

WATCHWORK, &c.—Where can I purchase watch materials and lever clocks? Is there any way of bronzing lead urns? H. J. F. (Winchester).

BOILER CLEANER.—Where can I obtain a patent boiler cleaner?—JAMES NEWTON.

ELECTRICITY.—In a cylinder electric machine, might a condenser made of alternate sheets of shellac varnished tissue paper and tinfoil be placed in the stand, and if so, how should it be connected with the cylinder?—T. TOTHERD. [Your stamps have been returned. We do not undertake the forwarding: sent to Mr. Woodcroft, Patent Office, Chancery-lane, they will procure what you require by return of post.]

SPOTS ON ZINC.—How can I remove spots of grease from polished zinc plates without injuring the surface of the plate?—W. J. P.

CASTINGS.—What can I run small castings of various metals in? Plaster is the best I have tried, but it will not last more than three times?—B. G.

TOOLS.—How can a tool be fitted on a lathe to turn ramrods and the like? B. GUY

PUNCHING WASHERS.—How can I punch washers so that washer and burr will leave the die freely with one stroke of punch, the washer to be complete?—W. PUNCHER

HARDENING PLASTER.—How can I do this for moulding without stopping the setting of it?—GUSTAVUS.

COATING PILLS. How can I do this, with sugar, similar to plum coating?—C. G.

WATCHWORK.—How are the wheels and pinions of watches made, and how the small screws blued?—BAGILT.

VENEERS.—Where can I obtain the narrow stringing used for inlaying with veneers?—COUNTRY NOVICE.

MICROSCOPE. It is desired to raise to about 200 a small compound microscope, magnifying about 30 diameters; can it be effected by placing a second object-glass, enclosed in a tube within the focus of the one I now use, or what other arrangement? and price of lenses?—G. T.

WINDOW SHOW.—How can I construct a machine to turn a stand and figure in a window?—SNIP.

OXIDATION.—How can I prevent this in steel after it has been highly polished, without affecting the lustre?—SPARROW-HAWK.

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MAGNETISM.—How can I produce this in steel?—J. B.

PLATINIZED SILVER.—Where can I obtain a plate of this, 6in. by 4in. wide, for a Smee cell, and its price?—W. H. H.

HEAT.—The simplest way of obtaining, equal in intensity to a potter's oven?—J. L

STONE CUTTING AND POLISHING.—Where can I obtain information respecting these; or the price of any work on them?—J. L.

CAMS.—How to turn cams, with different lengths of dwell?—J. P.

TELEGRAPHY.—Where to purchase, and price of the work on telegraphy by Culley, of Bristol?—E. MCGURK.

FRETTING AND MOULDING MACHINES.—Can any one tell me of a book on these, where published, and price?—J. HERBERT

VARNISH.—Can one be made from olibanum?—DABBLER. (1) Use a good scrubbing-brush and sand.]

LACQUER.—Wanted, a good recipe for making green lacquer.—AMATEUR.

GRAVITY.—Wanted, to know how to find the centre of gravity in any solid body, a bit of wood for instance?—C. R.

FIRE.—Why does fire die out under the action of the sun?—F. MASON.

ANILINE GREEN.—Where can I get information respecting Simpson, Maule, and Nicholson's method of producing?—G. L.

POLAR AXIS.—Wanted the length, in feet, of the earth's polar axis; also the diameter of the equator of a circle, but if an ellipse, the length of the two principal diameters, in feet, with the longitudes of their positions. Captain Clark's (Memoir's R. Astronom., Soc., 1860) would be most satisfactory.—T. C.

FULHAM RAILWAY.—How is it getting on?—J. J. AYLING

RUST ON WIRE.—How can I remove, without injury, rust from wire netted window blinds?—A. SMITH.

ELECTROTYPY.—How are plaster figures prepared for electrotyping?—F. B.

ENGRAVING.—Does any one know of a work on this art, and the tools?—H. GILBERT.

SHOEMAKER'S BENCH AND RIVETTING MACHINE.—Where can I see these, in or near to Birmingham?—S. L

DRILLING.—I have a surface of cast iron to drill with 4,000 holes, 3-32 inch in diameter, through 3-16 inch stuff. Have tried every shape of drill, at all tempers? am beaten? can't make drills fast enough. Will any one help me in my quandary?—VULPES.

COVERED COPPER WIRE.

Sir,—Allow me to say that No. 35 B. W. G. copper wire, is under rather than over 1500 yards to the pound, and when covered with silk, if any amateur thinks he will get more than 1400 yards in the same weight, he is woefully mistaken. I know Silvers 35 wire very well, and the above applies to it.

Mr. Preece gives the diameter of No. 35 as ·005; but it is not the B.W.G. 35.

You may call any gauge you please by any number you please: but I take my stand upon the B.W.G., and say the length is as above given; and if any one doubt my word, let him go to a Birmingham wire drawer, and get a pound, and test it for himself.

Since however, there is such an utter dissimilarity in different gauges, it would be desirable to abolish them altogether for fine wires; they are not to be depended upon for accuracy.

It is, doubtless, convenient in the trade to denote a particular size by a number which corresponds with some standard gauge, but it would be better to call all sizes of wires by their diameters; or, if this be found impracticable, it is a pity some standard gauge is not adopted

But your correspondent found the diameter of his wire to be ·005, and to measure, when covered, 108 yards to the ounce.

Mr. Preece also finds the same diameter for No 35; but the weight of one mile of his is ·4012 lb., or more than double the length of Mr. Williams's, the diameters being the same.

Now, in electrical experiments, accuracy is essential, and an amateur should know as near as possible what length he will get of a given number, and weights of covered copper wire, otherwise his experiments, calculations, deductions, and the rest, are worthless. 400 yards difference between your No. 35 and mine, my friend, is no joke; but you are a luckly dog it seems, and got No. 36 at No 35 price. May every reader of these pages who want a pound of wire be equally fortunate S. TAYLOR.

HEATING, &c.

Sir,—In reply to Seghill.—For a house the size mentioned, he would be better supplied with hot water by having a tank, which he may place anywhere as near the boiler as possible, if it is six or eight feet above the boiler, to hold 40 gallons, and the boiler 30. The boiler to be supplied from the main cistern by ¾ inch lead pipe, without any branches, and the boiler and tank to be supplied with strong 1″ lead pipe. The hot from the boiler top, to underside of tank, and the return from the tank out at the side a little above the centre into bottom of boiler.

The tank is part and parcel of boiler, and, as the water commences to heat, so it revolves, the supply through the house to be taken from the top of the tank, and led away through a ¾ inch lead pipe to the different branches, to be always on the ascension to the steam or safety pipe. For a main pipe he may use 1″ pipe; but I think ¾ inch inside is plenty.

If the house is not large, he may have plenty of hot water without a tank, with a boiler the same size, to be supplied in the same way from the main cistern, and branching off as before. The reason why there should be no branches off the supply to the boiler for fear that it might come to draw from supplying it, and there is a danger of a cock being left open, and then by endangering the boiler and life. MCRAE.

THROW OF VALVE.

Sir,—A. K. B. wishes to know what I mean by the throw of the valve. It is just equal to the travel of the slide. He also thinks there must be some mistake as to the letters G, I, F, but they are quite correct. Set the line G. I, F, at right angles to the crank, the same as in the diagram. The diagram will either do for engine with or without link motion. The throw of an eccentric is equal to twice the eccentricity of the inner circle keyed on the shaft.

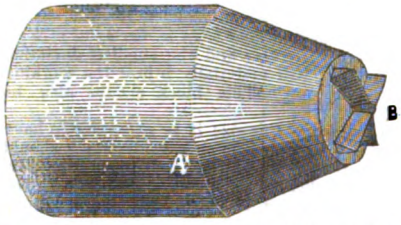
JAMES MORRISON.

Sir,—In reply to Cagliostro, in No. 30, September 27th if he cannot find Beeton's book of "Parlour Magic," he may procure from almost any respectable bookseller, or, for one penny additional, from the publishers, Messrs. Cameron and Co., Publishers, 88 and 94, West Nile-street, Glasgow, "Parlour Magic," price 3d, "Tricks and Delusions," with cards, 3d, "Whole Art of Magic," 6d., "Boys' Book of Magic," 1d. D. MCCANN.

AIR PUMP PACKING.

Sir,—W. Taylor recommends a strip of bladder for the valve of an air pump; he will find a strip of oil silk much better, as it will not get hard and stiff like bladder, and thus prevent the free passage of the air. F. HART.

Sir,—In answer to R. T. S., the simplest form of chuck for turning brass rods, &c., is this. A plain chuck of any metal (A) with a coned end, has four small wedges B, arranged in the form of a cross, and screwed into the end of the chuck. By making a crosscut in the end of the rod to be turned, the wedges B take into the crosscut and hold it effectually.



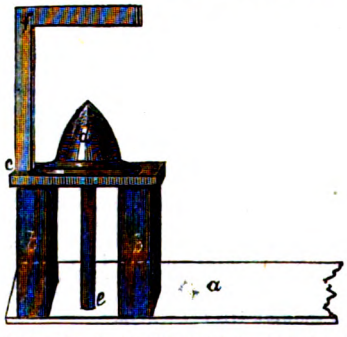
The quickest way to make a chuck of this kind is, I find to solder the wedges on a brass or pewter chuck. I have had such a one in use for turning iron and brass rods for years past. It is not my own invention,

T. E. MERRIT.

SIMPLE FURNACE.

Sir,—I am pleased to see my small furnace has given satisfaction to Amateur Mechanic. I think he might obtain a single crucible from Mr. Statham, chemist, 111, Strand, W.C. I think by attending to the following description and diagrams, Amateur Mechanic will be enabled to construct one for himself of a superior kind, and suitable for the furnace at a small outlay.

Two parts of fine ground raw Stourbridge clay, and one part of the hardest gas coke previously pulverized and sifted through a sieve (the coke must not be too fine, or the pots are liable to crack), mix with the proper quantity of water, and tread the mass well. The pot must be moulded on a wooden block, constructed similar to the following:—



A, the bench; C, B, two uprights supporting a cross board C; D, the wooden block on which the pots are moulded, supported on spindle E, which turns in a hole in the bench; F, a guage to regulate the thickness of the melting pot. He should also have a cap of linen placed wet on the core before the clay is put on to prevent it from sticking, and have a wooden bat to assist in moulding.

A pot thus constructed when wanted for use is first warmed by the fireside, and then laid in the furnace with the mouth downwards, the red cokes being previously damped with cold ones, in order to lessen the heat; more coke must then be thrown on till the pot is covered, and it is then brought to a red heat gradually. The pot must then be fixed mouth upwards in the furnace without being allowed to cool, and must be charged with cold iron; in a short time the iron will be melted (it must be so placed to be within a little distance of the top). A pot constructed thus will last for fourteen or eighteen meltings, provided it is not allowed to cool in the intervals. Should it be allowed to cool it will crack. The best plan is to allow it to cool gradually in the ashes.

Will some subscriber inform me how to construct a small set of figures to work by clockwork similar to those exhibited at Bristol. EDWARD MCGURK.

1, Houndwell View, Southampton.

TELESCOPE, MICROSCOPE, AND BAROMETER.

Sir—Satellite can scarcely be serious in enquiring how to get up a telescope with a "12 inch object glass, cheaply." Messrs. Merz and Son, of Munich, are probably the only opticians who would undertake a glass of such aperture. Messrs Cooke, of York, might, but I am uncertain as to this, and they would certainly not let Satellite have it under a thousand, or more likely eleven hundred pounds. An eye tube with glass complete may be bought for a sovereign.

J. Whitehead may obtain Collins' Dissecting Microscope at 77, Great Titchfield-street, Portland-place, London; the price is two guineas.

Finally, in reply to Torricelli, there is no fixed proportion between the area, or rather bore, of the tube of a standard barometer and that of the cistern; and for the simple reason, that in all standard instruments the scale terminates downwards in a fine ivory point, which is always made to coincide with its reflected image in the mercury in the cistern before taking an observation by either raising or depressing the moveable bottom of the cistern. The scale of inches thus always starting from the surface of the mercury, there is no correction to be made for "capacity," and thus all need for knowing the relative areas of the tube and cistern is obviated. AN AMATEUR TURNER.

Sir,—In answer to Torricelli, No. 31, I find there is no reason why the diameter of the cistern of a barometer should bear any ratio to the bore of the tube. The most approved standard barometers have a movable bottom to the cistern, to allow of adjusting the surface of the mercury to the zero of the scale. In making an immovable cistern, however, it would be advisable to consider the diameter (supposing the shape to be cylindrical), which will the least vitiate the reading of the scale, supposing it to be fixed. Let D = internal diameter of cistern; d = do. tube; B = range of barometer column; b = corresponding range of the surface of the mercury in the cistern. Now, the scale is only correct when b = o; which it never can be with a fixed cistern, however large. Taking the bore of the tube at ⅛ of an inch, B = 1 inch and b = ·01 inch. We can calculate D as follows:—

Volume of $B = 1 \times \frac{1}{8} \times \frac{1}{8} \times \cdot 7854$; do. $b = D^2 \times \cdot 01 \times \cdot 7854$. Since whatever mercury passes from the tube enters the cistern *et vice versa*, the volumes of B and b are equal. Hence, $D^2 \times \cdot 01 = \frac{1}{8} \times \frac{1}{8}$: whence $D = 6\frac{1}{4}$ inches; rather inconveniently large. It would be better to have a smaller cistern with a movable bottom, or a small intact cistern, and apply a movable scale to the barometer.

In this calculation I have omitted to allow for the annular space occupied by the end of the tube, which dips into the mercury in the cistern, as it would have no appreciable effect upon the result. RICHARD STRACHAN.

11, Offord-road, Barnsbury, N.

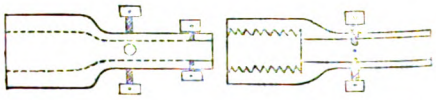
TELESCOPY.

Sir,—Satellite will find all he wants to know in "The Telescope its Construction, and Use," by J. T. Slugg, Simpkin, Marshall, and Co, London. Price 1s 6d. A 12-inch achromatic object glass is an expensive affair. Let him make or buy a silvered glass speculum, and fit up a reflector. It will cost a great deal less, and be more pleasant to use.

OLD CHARLIE.

CHUCK FOR SMALL WORK.

Sir,—In answer to R. T. S., who requires a chuck for turning small brass rods, I think he will find this a very handy one:—



It consists of a chuck and eight screws; the chuck is hollow, the end being enlarged, if required, to screw on the mandril Four screws are placed at one end at equal distances on the circumference from one another, and the other four are placed at the other end, equal distance from one another, and opposite to the spaces made by the other four. Holes are drilled through the ends of the screws to admit of being easily tightened. G. S.

STEEL POLISH.

Sir,—The polish on flat-steel pieces in fine watch work is produced with oil stone dust, burnt Turkey stone, and a steel polisher, soft steel, bell metal, and sharp stuff, grain tin and glossing stuff. The metals are squared with a file, and vary in shape according to the work in hand.

E. Feather.—The oil recommended by Mr. Denison is neat's foot oil, well stirred about in water, skimmed off, and filtered once or more through blotting paper until it is quite clear. I never use any other than olive oil, and, by experience, I know that when pure, it is well suited for the purpose. Small emery sticks (so called in the watch trade) about three inches long, and small in the round are used for chamfering dial holes. I have tried to obtain and failed Perhaps some of your readers will instruct me how to make, or where to obtain the same?

A LIVERPOOL WATCHMAKER.

AQUARIUM FOUNTAINS.

Sir,—In answer to W. Brown in your last number, I made a fountain in my aquarium in the following manner:—

I fastened on the wall near the ceiling a tin vessel, from that I carried a dead pipe one-eighth of an inch in diameter. I let that pipe go through the bottom of my aquarium, and then through the rock work. In the end of the lead pipe I fastened a piece of glass tube with a very fine hole, and about 1-64 inches in inside diameter, and I let that pipe finish just at the water surface. PHILIP.

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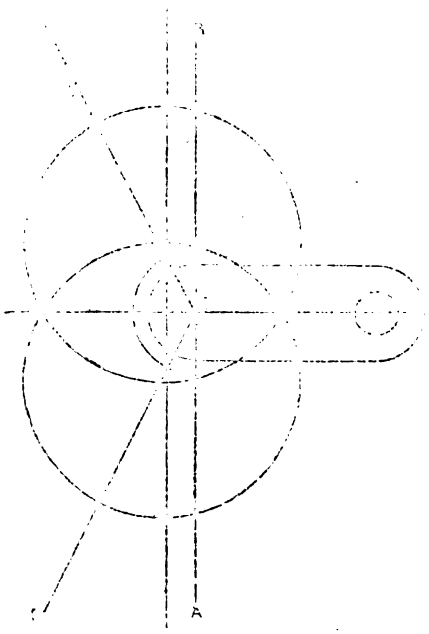
NEGATIVE SLIP.—ECCENTRIC.

Sir,—I entirely differ from Mr. Colley in his theory concerning negative slip He says that the screw being propelled at a greater velocity than the water can free itself, it causes a round column of water to hold in between the blades.

Now, the screw cannot hold the water in the blades, and continue to revolve; for it would then be carried round, and forced out of the periphery by the centrifugal action of the screw, and not only that, but the pressure ahead of this screw would (if there were no other cause) itself be sufficient to force the water through the blades; the reason why the pressure does not force it through the blades is this:—

In all vessels passing rapidly through the water there is a current of water following the ship and this current pressing in opposition to the water coming from the screw causes the screw to retain the water within the blades, till, by their centrifugal action, they throw it out at the periphery, something like the action of a centrifugal pump. I must not forget to mention that the screws in which negative slip chiefly occurs, have a pitch less than their diameter, and when therefore the velocity is greater than if it had been a coarser pitch.

With respect to the Eccentric subject, I think a better way to place them in the proper positions on the shaft is as follows:—



Draw a line A, B, at right angles to the crank across the centre of the shaft, and from it, at a distance equal to the lap + the lead, draw another line C, D, parallel to A, B: then, with E as a centre, describe a circle equal in diameter to the travel of the valve; draw the lines E, F, E, G through the points where the circle intersects the line C, D; the lines E, F, E, G, are the centre lines of the eccentrics.

I may here state for the information of A. K. B., that the above method answers as well for the link motion with the rods connected at the ends of the link, as with those connected in the ordinary way with this exception that the rods when connected at the ends should be crossed on the crank, when the link is connected direct to the valve spindle, and *vice versa* if by the intervention of levers.

M. J. WHEATLEY.

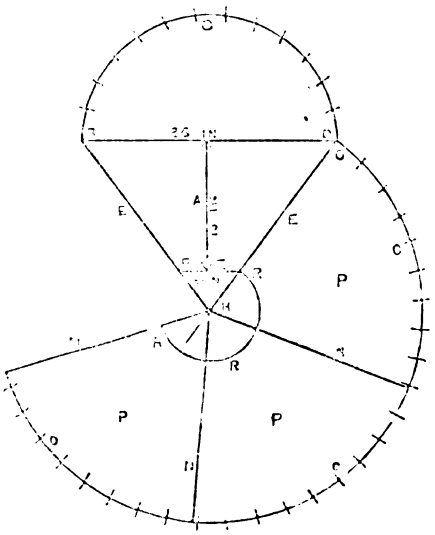
GRINDING AND POLISHING LENSES.

Sir,—In answer to D. K., in No. 30:—We will suppose the focus of the required lens is equal to the radius of curvature, when it is for a double convex or double concave, and twice the radius when it is for a plane convex or plane concave. 1st. Cut a curve (template) from a piece of zinc on anything stiff. 2nd. Take a piece of sheet brass not less than 1-16 in. thick, and rather larger than the diameter of the intended lens. Strike a circle on it and beat it into a cup or hollow shape, if for a convex lens, as near as possible to the curve of the template. 3rd. Take a piece of wood, turn a corresponding hollow, and then screw on the piece of brass. A good plan is to make the cup of a square piece of brass, the four corners serving for screws. 4th. Turn the brass cap which we call a tool, to the correct curve of the template. 5th. The tool being provided, take a piece of glass and chip it round to a circle, rather larger than the diameter of the lens. Cement it on to a ribbon roller with pitch, and then with sand, or emery and water, work the tool over the glass with circular and transverse motion until its surface corresponds with the tool. 6th. Well wash the glass and tool, take fine flour emery and use it in a similar way to the sand until the coarse face and scratches are out, and then using only the emery mud, sparingly, a fine opaque surface approaching to a polish will appear. 7th. Well wash the lens to remove all the grinding particles. Take another ribbon roller and cup it out similar to the brass tool, fill it with hot pitch, and over it stretch a piece of cloth, and then press the lens into it, moving it to form the shape of lens, cut off the surplus cloth, and then a polisher will be provided. 8th. Take crocus powder or putty powder, and clean water, damp the cloth and sparingly apply the powder, and with patience and perseverance D. K will succeed in manufacturing lenses. I have thus made lenses varying from one tenth to sixty inches focus, and from one tenth to three inches diameter. If D. K's. object be amusement and experiments, I advise him to proceed and allow seven years to accomplish the task. In the meantime study the laws of optics. Read Dr. Brewster or Dr. Lardner's works, and with compass and paper trace the action of light through every variety of lens. That was the way I started. Without it, I think I should not have understood one half of the formulæ given If he wish to make achromatic combinations he must know something more than grinding and polishing.

YIXAS.

ANSWERS TO HAND CHISEL.

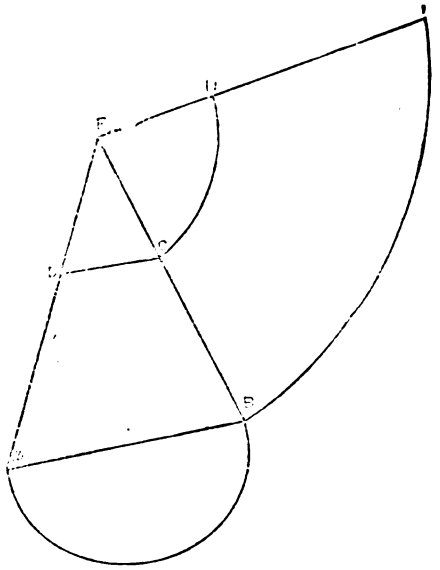
Sir,—In answer to Hand Chisel's inquiry, I think the following method will answer his purpose:—



Draw the centre line A, then set off B, D, 18 inches from the centre, and with the same radius strike the circle G; then set E, F, F, 4 inches from the centre line A, and strike the lines E, E, to cut each other at H, and with the radius H, D, strike the circle O, and then with radius H, E, strike the circle R. He must now take his compasses, and set them, say, to half inch beginning at B, and ending D, as shown Counting the number of half inch between B, D *via* G, and then set off twice the number on O draw lines N, N, N, then P, P, P are the three pieces required to make your pan. There is nothing allowed for lap of joints. You must allow three times the thickness of your plates extra.

R. MELLOR.

Sir,—The following, I think, will answer the purpose of Hand Chisel:—



A, B, C, D, required frustrum or pan, continue the lines A, D, and B, C, until they meet at E; then with radius E, C, describe the arc C, H; also, from E, the arc B, I, make B, I equal in length to three times A, B, draw the line E, I and B, C, I, H, is the form of plate required. Add 1½ inch per foot diameter, including lap of A, B, to B, I, which will be near enough for zinc pan.

McRAE.

BELTING.

Sir,—In answer to Pneumatic, I beg to say that my ¾ inch banding is 4d. or 4d per foot, according to strength; this is the strongest softest, and most pliable leather made, and does not get hard by use.

JOSEPH WHITE.

Sir,—Can any of your readers inform me how I may regulate my metre to save gas in the burning, as I burn twice as much as my neighbour, from one light, and with same burner?

D. MCCANN.

HARDENING, TEMPERING, AND COLOURING STEEL SAWS AND SPRINGS.

We have occasionally been asked for some information on these points, and of late the inquiries have been so numerous that, with an accumulation on hand, we have determined to give a short article on the subject, founded on Mr. Holtzapffel's excellent book. Watchmaker's drills, then, to begin, of the smallest kind, are heated in the *blue* part of the flame of a candle; larger ones are heated with the blowpipe flame, applied obliquely, below the point. When these are thin, whisking in the air may cool them, but the usual plan is to thrust them either into the tallow of the candle or the oil of the lamp. They are tempered either by their own heat, or by immersion in the flame below the tool's point. The majority of tools—chisels, gouges, &c., are heated in the open fire, drawn backwards and forwards through it to equalise the temperature applied; they are then plunged vertically into water, and moved laterally to expose them to the cooler surfaces of the water. If needful, dipping need only be performed on a part of the tool, the rest being left soft. Forged pieces should have all the scale removed before dipping. Hatchets, adzes, cold chisels, and tools in which the bulk is great compared with the surface to be used, are only partially dipped; they are afterwards let down by the heat of the rest of the tool, and when the temper colour is attained, they are totally immersed. With the view of removing loose scales rubbing in dry salt is sometimes resorted to before plunging, to give a cleaner face.

Oil, or various mixtures of oil, tallow, wax, resin, &c., are used for needles, fish-hooks, steel pens, springs, &c., requiring a milder hardness than that given by water. Thus pens are heated in large quantities in iron trays in a furnace, and then hardened in an oily mixture. Generally, oil, the boiling point of which is the same as the temperature suited to letting them down, is used for expedition. Saws and springs are hardened in the same manner in various compositions. That used by an experienced saw maker is two pounds of suet and a quarter of a pound of bee's wax to each gallon of whale oil; these are boiled together, and serve for most kinds of steel. The addition of black resin, to the extent of a pound to the gallon, makes it do for thicker pieces, but the resin should be used with judgment, or the works will become too hard and brittle. Mr. Gill's recipe is as follows:—20 gallons spermaceti oil; 20lbs. beef suet rendered, 1 gallon neat's foot oil; 1lb. pitch, and 3lbs. black resin. These last two must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until the moisture is entirely evaporated, and the composition will take fire on a flaming body being presented to its surface, but which must be instantly extinguished again by putting on the cover of the vessel. The saws are heated in long furnaces and immersed horizontally and edgeways in a trough containing the mixture; two troughs are commonly used, the one until it gets too warm, and the other for a period. Part of the composition is wiped off the saws with a bit of leather, when removed from the trough, and they are heated one by one over a clear coke fire, until the grease fires. When the saws are wanted rather hard, but little of the grease is burnt off; when milder, rather more; and for a spring temper all is burnt off. When the work is uneven as to substance, a second and third dose is burnt off. Gun-lock springs are sometimes *fried* in oil for a considerable time on an iron tray; the thick parts are then sufficiently reduced, and the thin parts do not become the more softened from the continuance of the blazing heat.

Springs and saws appear to lose elasticity after hardening and tempering from the reduction and friction in grinding, &c. But towards the conclusion of their manufacture elasticity is restored partly by hammering and partly by heating over a clear coke fire to a straw colour: the tint being removed by weak muriatic acid and well washing. Watch springs are hammered out of round steel wire, until they fit the gage for width, which at the same time ensures equality in thickness: the holes are punched in their extremities, and they are trimmed on the edge with a smooth file. The springs are then tied up with binding wire, in a loose open coil, and heated

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upon a perforated revolving plate over a charcoal fire, hardened in oil and blazed off. Next, the spring is distended in a metal frame, and ground and polished with emery and oil between lead blocks. At this point its elasticity seems gone, but this is quickly restored by hammering on a bright anvil. The colouring is done over a flat plate of iron, under which a spirit lamp burns: the spring is continually drawn backwards and forwards over this, about two or three inches at a time, until it assumes the orange or deep blue tint throughout as required. The last process is to coil the spring into the spiral form, which is done by a tool with a small axis and winch handle, and does not require heat. The balance springs of chronometers, in the form of a screw, are wound into the square thread of a screw of the appropriate diameter and coarseness; the two ends of the spring being retained by side screws; and the whole is carefully enveloped in platinum foil, and bound tightly with wire. The whole is then placed into a piece of gun barrel and heated, then plunged into oil, which, without discolouring, hardens the spring; the covering is removed, and the spring let down to the blue before removal from the screwed block. The hair springs of the best watches are hardened in the coil on a plain cylinder, and curled into a spiral between the edge of a blunt knife and the thumb. Mr. Dent, in his lectures on the time-piece, stated that 3,200 springs weigh only one ounce; and as soft springs are worth 2s. 6d. each, and the hardened and tempered ones worth 10s. 6d. each, the value of the steel, originally less than 2d., is raised to £400 and £1600 respectively!

DURING last year 2,887 ounces of gold were procured from 2,336 tons of quartz, which were mined from the slate rocks of Merionethshire.

IT has been found that half a grain of lithium given to a guinea pig for three consecutive days could be detected in every texture of the body.

RAMSBOTTOM'S MANUFACTURE OF STEEL AND IRON.

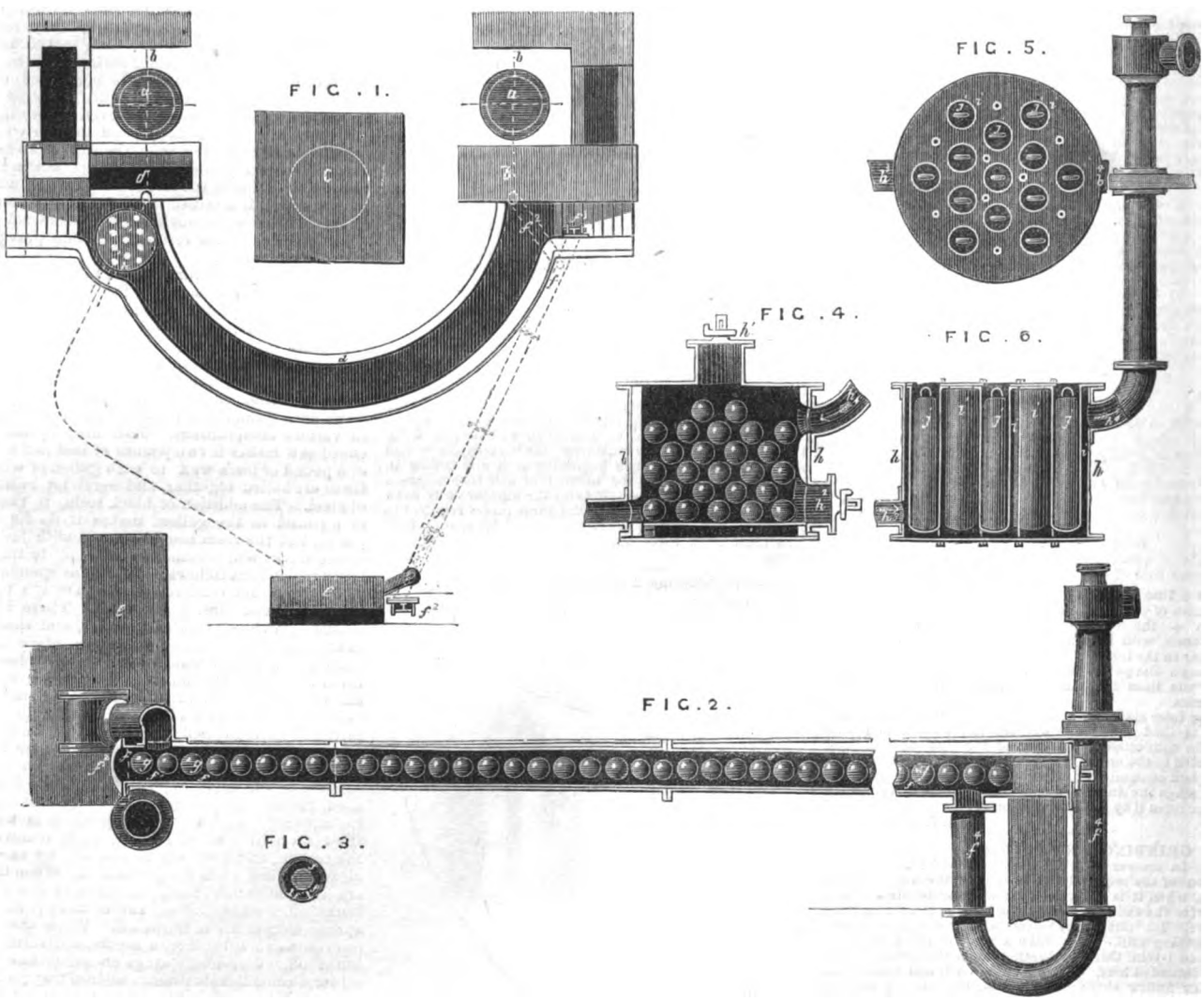
This invention, patented by Mr. J. Ramsbottom, engineer, Crewe, is applicable to the manufacture of steel and iron by the atmospheric process commonly known as the Bessemer process, and as described in the specification of letters patent granted to Henry Bessemer on the 12th February, 1856, No. 356, and it consists in certain improved apparatus for heating atmospheric air or other gases before they are forced through the liquid metal in the converting vessel. The apparatus for heating the air or other gases may be constructed as shown at Figs. 1, 2, and 3, in the accompanying engraving.

Fig. 1 is a plan of part of an appararus for converting iron into steel according to the Bessemer process above referred to.

a, *a* are sections of the converting vessels, which oscillate on the centres indicated by the dotted lines *b*, *b*; *c* is the foundation plate of the crane for supporting the laddle by which the molten metal is poured into moulds ranged round the semicircular wall *d*; *e* is the chest containing the valves for regulating the blast, and *f* is the series of pipes for conveying the blast or compressed air forward to the converting vessel. This pipe the patentee now proposes to make of about twice the area of the pipes hitherto employed, in order that it may afford room for the heated spheres *g*, which are supported on rails f_1, fixed in the pipes as shown best in Figs. 2 and 3. Each end of the pipe *f* is closed with a lid, and the lower end, or that near the converting vessel, is provided with a stop block to prevent the spheres injuring the lid f_3. This end of the pipe *f* is connected to the trunnion of the converting vessel by the syphon pipe f_4. During the melting of the metal for conversion, the spheres are being heated by the waste heat from the melting furnace, or in a suitable oven provided for the purpose, and just before the metal is run into the converter the spheres are run from the oven upon suitable ways to the end f_2 of the pipe *f*, and are thence passed forward into the pipe *f*, the lid f_3 having been previously secured to the other end of the pipe; the lid f_2 is then secured, and the blast, in passing through the pipe *f*, becomes heated to the required extent before entering the converter. The relation between the heating surface and the quantity of heat contained in the spheres may be varied at pleasure, either by altering the diameter of the spheres or by making them hollow. When the blowing is completed the lid f_3 is removed, and the spheres are allowed to run out, or are blown out of the pipe *f* into a box, in which they are taken to the oven to be re-heated for further use. It is evident that the same spheres may be used for heating the blast of any convenient number of converters. The pipe *f* may be lined with fire-bricks or other non-conducting substances, so as to prevent loss from radiation and reduce the disturbances arising from expansion and also the reduction in the strength of the pipe from excessive heat, when the temperature of the air is required to be very high.

Fig. 4 represents a modification of the improved heating apparatus, *h* is a vessel lined with fire-brick or other non-conducting substance. At the top of the vessel is a manhole provided with the lid h_1, and at the bottom is the opening h^2: h_3 is the pipe for admitting the blast to the vessel *h*, and h^4 is the pipe in communication with the trunnion of the converter. The spheres similar to those shown in the pipe *f* having been heated, are allowed to drop into the vessel *h*, the lining of the lower portion of which is protected by a metal plate or by pieces of broken fire-brick, or tap cinder, or other suitable material. The blast becomes heated in passing through the spaces between the spheres.

In Figs. 5 and 6 the blast is heated in passing between the metal tubes *i*, which are secured by flanges or otherwise to the top of the vessel *h*. The tubes *i* are heated by the heaters *j*, which are lowered into the tubes previous to or during the time that the blast is being admitted to the vessel *h*.



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The top and bottom of the vessel are held together by vertical stays to resist the internal pressure of the blast, or the tubes may serve as stays by connecting the lower ends to the bottom of the vessel. In this case the heat is conducted through the metal of the tubes, and the heating surface is therefore less effective than when the heat is applied direct as before described. To compensate for this the surface of the tubes is made proportionately greater. It is preferred to make the cylindrical tubes *i* of cast iron, as the pressure is external, and this metal is comparatively strong to resist compression when heated.

The modes above described of constructing the improved heating apparatus are only given as illustrations of the mode of heating air under considerable pressure, and may be considerably modified, as, for instance, more than one line of spheres may be placed in the pipe *f* above described, or more than one pipe with spheres or other heaters may be used, or the heaters may be cylindrical or of any other form that can be conveniently introduced; or in the apparatus shown in figs 4, 5, and 6, ingots from a previous cast may be used as heaters, either by being placed in the vessel *h*, Fig 4, or in the tubes *i* in Figs 5 and 6.

This invention also consists in forcing into the converter, along with the atmospheric air or other gases, carburetted hydrogen gas, or ordinary illuminating gas, in about the proportion of one part of the carburetted hydrogen gas to thirty parts of atmospheric air, to eliminate sulphur and phosphorus from the converted metal; the object being also to render available certain descriptions of iron which, owing to the presence of these elements, cannot now be treated by the Bessemer process.

GAUGES FOR WIRE AND SHEET METAL.

(*Concluded from page* 64.)

The column to which Section 2 is prefixed in the table inserted in last week's number is called the "metal" or "plate gauge," in contradistinction to the wire gauge. Its intervals are closer and smaller than that for wire. Thus the No. 1, which in this series is the smallest size notch, is 4-1000ths or 1-250th part of an inch wide, whilst the largest or 36 notch measures 167-1000ths, or is evidently meant for the sixth part of an inch. When thicker metals are wanted, then measures are sought in the Birmingham wire gauge—thus the 36 on the gauge-plate nearly agrees with the 8 on the wire gauge; and so the Nos. 7, 6, 5, to 0000 of the latter are then employed for thicker metals than can be measured by the plate gauge. Frequently the plate gauge ends at 24, which number agrees with 14 of the wire gauge, and then the Nos. 13, 12, 11, to 000 of the latter are similarly resorted to for thicker metals. It is evident these combinations lead to confusion.

Sheet metals also present much variation in their description; for instance, zinc has a gauge thus constituted:

Sheet zinc.....	6, 7, 8, 10, 11, 12, 13, 14, 15, 16	are all nearly
B Plate gauge	4, 4½, 5, 7, 8, 9, 10, 11, 12, 13	alike.

These thin sheets of zinc, measuring from one to four hundredths of an inch in thickness, are principally used for gutters, roofs, and small works, by the hammer. Thicker zinc plates, from five to eighteen hundredths thick, or those used for zincography, door-plates, and engraved works, are commonly made from notches 18 to 7 of the Birmingham wire gauge, without alteration of the numbers, but running the reverse way of those of the other series used for zinc.

The fourth, fifth, and sixth columns of the table constitute one series of gauges, employed exclusively for the bright steel wire prepared in Lancashire, and the steel pinion wire for clock and watchmakers. The smallest notch in this series is No. 80, and measures 13-1000ths of an inch, or about 1-12th of an inch; and the first part of this series continues with No. 1, which measures nearly one quarter of an inch (227-1000ths). The steel wire gauge apparently ended at this size in the first instance, but has since been extended by a second series to the diameter of 494-1000ths, doubtless intended for half an inch. To avoid confusion, the larger sizes are distinguished by letters, from A to Z, and these terms are then continued under the denominations A1, B1, &c., which latter size is the largest, and measures 494-1000ths of an inch, as shown. There are many other arbitrary gauges—among them those used by rod-iron makers, nail-rod, button, and watch-work makers, also for gun and rifle bores, which need not be particularized. Suffice it that great confusion exists, and that it is high time this arbitrary, uncongruous system was removed, and the decimal divisions of the inch employed, and those under their true appellations. Thus for most purposes the division of the inch into 100 parts would be sufficiently minute, and the measures, 1, 2, 5, 10, 15, or 100 hundredths, would be also sufficiently impressive to the mind; then quantities might be written down, as 1, 2, 5, 10, 15, or 100 hundredths, as the decimal mode of expression might, if preferred, be safely abandoned, and the method would be amply distinct if the gauge were marked "hundredths"—quantities which easily admit of verification.

SWEDENBORG.—No. III.

(*Continued from page* 63.)

I THINK before my reader has finished the perusal of this chapter he will be more interested in the subject of these papers than he has, probably, yet been. It may be added, *en parenthese*, that the "Principia"—the work we are considering—is rendered very interesting to numbers at the present time, as containing the germs of the system of geological science which now occupies so much and deserved attention, in connection more especially with the duration of our supply of coal.

A remarkable proposition is contained in the chapter on the means which conduce to true philosophy and on the true philosopher—that no one can acquire the former, and not become the latter; also that no one can become a true philosopher who is not a good man. It has been contended by those who do not know anything about the work, that there is an air of mysticism about it which paralyses attention. That is, I suppose, the attention of suppository individuals. A late Professor in a University said of it—"It is an extraordinary production of one of the most extraordinary men that ever lived. . . Many of the experiments and observations on magnetism presented in this work are believed to be of much more modern date, and are unjustly ascribed to much more recent authors." The pervading idea is the recognition of external objects as the product of internal powers, and this, not as to form only, but as to their matter and subsistence. Two things are virtually assumed in all its deductions—the absolute reality of the Infinite and the existence of finite entities; "it has a good foundation therefore in common sense, and has necessarily a religious tendency." Descending from the "first natural point"—by which pure motion is indicated—the author defines the phenomena of heat, light, magnetism, and the elementary substances themselves, as so many graduated manifestations of infinite activity. Many recent "discoveries" are anticipated, such as the identity of electricity and lightning, and the stellar constitution of the Milky Way, and there is promulgated a complete theory of tellurian magnetism. In June, 1752, Franklin performed his celebrated experiment; in 1733 the same truth is reasoned out by Swedenborg as a minor consequent to his philosophy. Respecting tellurian magnetism our author's theory proves the existence of the magnetic element; establishing that, the particles of this element being spherical, the tendency of their motion is either spiral, or vortical, or circular:—the importance of this in the connection will presently be seen;—that as each of these motions requires a centre, whenever the particles meet a body which is adapted to their motion, by configuration and position of parts, they avail themselves of it, and form around it a magnetical vortex; and that if this body possesses an active sphere of its own, and its parts are flexible, and if its motions are similar to that of the particles, it will be so much the more disposed to admit them:—thus, that the magnetism of bodies depends on their form. Some of the results of this theory were confirmed in a brilliant manner by our own Faraday; and it is probably destined to take its place, along with Swedenborg's general doctrine of spheres, or exhalations, as the only hypothesis capable of explaining the phenomena and correlation of forces. Respecting the phenomena of planetary motion, various hypotheses had been constructed, on the general principle that the planets were carried round the sun by its supposed vortex. Kepler, Descartes, and Leibnitz had been thrown into the shade by Newton before the publication of the "Principia," but undismayed its author attempted to reconcile the laws of gravity with the existence of a vortex, and, though it still remains for a yet higher authority to pass judgment on this attempt it is sufficient evidence of Swedenborg's genius that the circumstances affecting the periodicity of the comets of Encke and Beila have left astronomers no alternative but an accommodation of this nature. He makes the magnetic element the agency which controls the planetary movements—resolves the power of gravitation into magnetism, and shows that precisely the same laws which govern a single particle of matter govern also the heavenly bodies in their orbital revolutions. Hear him:—"The magnet with the play of its forces we both see and we do not see. . . . . In the magnet and its sphere there is, however, a type and effigy of the heaven; a mundane system in miniature presented to our senses and brought within the limits of our comprehension. In the sphere of the magnet are spiral gyrations or vorticles; in like manner in the sidereal heavens there are spiral gyrations and vortices. In every vorticle round the magnet there is an active centre; in every vortex in the heaven there is also an active centre. In every vorticle round the magnet the motion is quicker near the centre than it is at a distance from it; the same is the case in every vortex in the heaven. In every vorticle round the magnet the spiral gyration is of greater curvature in proportion to its nearness to the centre; the same is the case with every vortex in the heaven. In every vorticle round the magnet there are, in all probability, corpuscles fluent round the centre and revolving round an axis; such also is the case with every vortex in the heaven. The vorticles round the magnet colligate themselves by means of their spiral motions, and, thus colligated form a large sphere; the same is the case in the sidereal heaven. . . All things are similar one to the other; because in small things as well as in large, nature preserves the greatest similarity to herself; especially as the vorticles round the magnet posses particles and elements of the same nature as the vortices of the great heaven; and inasmuch as these vortices are similar, as well as their causes, therefore the effects are similar? Our author further remarks that the axis of our own universe is in the galaxy; that here consequently the magnetic power is the strongest, and hence that here we find the greatest condensation of solar systems; that our own sun is not in this axis but a little out of it, and hence the original cause of the ellipticity of the planetary orbits, which he supposes to be attracted in the direction of the axis of the common sphere. It should not be lost sight of all through that it is a stand-point of our author that the visible world is the out-birth of the invisible, and that the manifestations of changes in the external are but manifestations of progression in the state of the internal—hence, according to this, no one can ever well understand the outer without having a knowledge of the inner. Admitting the first part of the proposition, all the rest follows as matter of course.

Respecting Swedenborg's cosmogonical theory it may be remarked that Buffon was acquainted with it, and, most probably, La Place also. The "Principia" was published ten years before Buffon's theory, and about twenty before that by La Place. According to our author the sun is the centre of a vortex; that it rotates upon its axis: that the solar matter concentrated itself into a belt, at the ecliptic; that by attenuation of the ring it became disrupted; that upon the disruption part of the matter collected into globes, and part subsided into the sun, forming solar spots; that the globes of solar matter were projected into space; that consequently they described a spiral orbit; that in proportion as the igneous matter thus projected receded from the sun, it gradually experienced refrigeration and condensation; that hence followed the formation of the elements of ether, air, aqueous vapour, &c., until the planets finally reached their present orbit: that during this period the earth experienced a succession of geological changes which originated all the varieties in the mineral kingdom, and laid as it were the basis of the vegetable and afterwards of the animal kingdom. Swedenborg begins at the centre, La Place at the circumference. Experiments are favourable to the former, and unfavourable to the latter. Again, Swedenborg alleged that there were seven planets created from the sun at the same time: over forty years afterwards Herschel, in gauging the heavens, confirmed the philosopher!

Again, concerning the stability of the solar system our author's theory declares that, as the solar system is carried along the milky path, and afterwards compelled to diverge therefrom, the planetary orbits will change their form and eccentricity to a certain amount, and then return to their original condition, when they will again change, and again return, and so on to eternity. La Grange's demonstration, forty-four years *afterwards*, is a direct proof of our author's theorem; and yet the doctrine of a cyclar return in the form of the solar system—now received as the most reassuring and beautiful conception of man—is known under the name of La Grange's Theory!

I may return to this part of the work in the next chapter—which may, perchance, be the last, owing to the heavy demands of business, but I cannot leave this without remarking that few who earnestly peruse his works can doubt the transcendancy of our author's genius, or object to his claims for the highest anticipative originality.

(*To be continued.*)

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BIRTH AND GROWTH OF THE IRON TRADE.*

By James Robertson.

(*Continued from page 68.*)

Cort's invention of the rollers was most important—in this respect, that before his discovery the smallest size of the bars drawn under the hammer was three quarters square; all below that size were made in the splitting mill, and came under the denomination of slit rods. Before that time—that is, the use of the splitting mill in this country—all the slit rods were imported from Sweden. The effect was most disastrous to the nail makers of Stourbridge, but the secret of the splitting mill was transferred to this country in a most singular manner, by the pertinacity of a very humble individual. This man was the founder of the Foley family; he was a fiddler by profession, and lived at Stourbridge when not on his travels, and although he was by no means remarkable amongst his fellows for penetration, yet he saw the great loss of time and labour which nail makers of Stourbridge experienced in cutting the iron for their nails out of flat pieces of iron, and he resolved to find out the secret. He fiddled his way to Hull, and thence worked his passage across the North Sea to Sweden; arrived there, we may justly presume he had a language to learn, as the Swedish tongue is not spoken with correct emphasis in Stourbridge, however well the tones of Foley's fiddle might be understood in Sweden. He elbowed his way to the ironworks, and became a great favourite with the workmen, to whom he played. He was an attentive observer of the process of rod slitting; he had seen the machinery, and, as he thought, had mastered its details. He disappeared from the ironworks, and worked his way back to England, to the regret of the admirers of his musical skill. Arrived at Stourbridge, he communicated the result of his voyage to two gentlemen in the neighbourhood: they had works built for the manufacture of slit rods, but when the necessary machinery had been fixed it was found that it did not answer the sole purpose of its creation—it would not act. Back to Sweden went Foley, with his fiddle, as before, to discover his error. The workmen, his former friends and admirers, were delighted to see him. To his inexpressible joy he was lodged in the splitting mill. He made sketches of the machinery to aid his memory; he impressed every detail upon his mind, and made the best of his way back to England, where the works were soon set going, and rod splitting was carried on with the greatest success. He not only enriched himself, but benefitted his countrymen. There are not many such surprising instances of indomitable perseverance as the one contained in this simple narrative.

Another vast stride in the development of the iron trade was the invention of the hot blast, by Mr. J. B. Neilson, civil engineer, of Glasgow, thirty years ago; previous to this it was thought, but most erroneously, that the colder the air upon entering he furnace the better would be the material produced; but the currents of cold air on entering chilled the material, and produced a pipe on either side of the furnace, the furnace having a double blast. These pipes often extended so as to meet in the middle of the furnace, but the duty of the keeper was to watch this and regulate the blast, so that the pipes might be neither too long nor too short. Mr. Neilson suspected that it was the presence of sulphurous vapour which injured the blast, and he concluded that, by heating the air of the blast before it went into the furnace, the evil would be avoided, as air will not support combustion until heated to a temperature of 1000° Fah., and that until it acquired that temperature it would act prejudicially upon the metal. The first experiments of the hot blast were made at a temperature of 300°, and the advantage immediately appeared, for during the first six months of 1829 the furnaces wrought with the cold blast required 8 tons 1¼ cwt. of coal (converted into coke) for the converting of 1 ton of cast iron; whilst during the first six months of 1830 the same quantity of iron, with a blast heated to 300°, required only 5 tons 3¼ cwts. of coal (converted into coke), which, after deducting 8 cwts. of coal employed in heating he air, gives a saving of 2 tons 10 cwts. of the coal employed in producing a ton of iron. In the course of the year 1831 the temperature of the blast was doubled, being made 600°, and the saving in fuel was enormous, for only 2 tons 13 cwt of coal (not converted into coke) were required to produce 1 ton of iron, for the increase of combustion with the blast at 600° precludes the necessity of coking before smelting, as the intensity of the blast compensates for the quantity of latent heat that must arise with the vapours expelled from the coals during combustion.

(*To be continued*)

NICKEL AND COBALT, AND THE GERMAN SILVER MANUFACTURE.

In an article published some years since in the *Mining Journal* the history of Wolfrom from the time it was regarded as an evil by the miner until it attained an enviable position was carefully traced; and in a highly interesting paper, of which the subjoined is an abstract, prepared by Mr. Stephen Baker, of Birmingham, and intended to have been read at the recent meeting of the British Association for the Advancement of Science, the history of the manufacture of Nickel and Cobalt is recorded in an equally instructive manner.

There are few metals, says Mr. Barker, whose history is more instructive than nickel. Originally to the miner a source of trouble and annoyance, it has by a happy combination of scientific observation and manufacturing enterprise in our countrymen—one may, indeed, say our fellow-townsmen—become developed into an important branch of manufacturing industry; and is under its various forms not only an article of luxury, but one of daily necessity to thousands. About the middle of the last century, previous to which nickel was unknown in Europe (though alloys were long previously known in China), the copper miners of Sweden and Germany came upon certain ores of a different character from any they had hitherto observed. They had something of the brilliancy of silver, with the reddish tinge of copper, or rather of bismuth. At Schneeberg, in Saxony, where from time immemorial rich silver mines had existed, fresh lodes of ore were laid open, so glittering and so full of promise as to cause much excitement, and great was the wrath and bitter the disappointment of the honest German miner when, after endless labour and innumerable trials, instead of the virgin white precious metal, ductile, malleable, indestructible by fire, all that he could get from the ores was a dirty whitish metal, brittle and friable, even to dust, under the hammer, and converted by fire into a greyish ash. Whenever the reddish-white ore turned up the miner knew that his labour was in vain, until at length, in sheer vexation, he nicknamed the new villanous ore "Nickel," and another and similar ore generally associated with it "Cobalt"—both these names being at that time applied by the superstitious German miner to certain gnomes, or evil spirits, who were supposed to have bewitched the ore, the mountain, and the mines.

Kronstadt's and Bergman's researches directed the attention of chemists generally to the new metal; and Thernand Lampadius and Busebius contributed to its history. Rechter, of Berlin, first produced it in a state of chemical purity in the years 1804, but only in small quantities. The method he adopted was by heating the oxide of the metal (probably with the accidental access of carbonic oxides) in porcelain retorts. It was at first classed among the precious metals. Its great resistance to fusion for a long time formed an insuperable bar to its use in the arts, until a method of alloying it with zinc was discovered; it then became easy to alloy it with other metals, and finally the alloy of the three metals—copper, zinc, and nickel—was known in common under the names of new silver, nickel silver, and German silver.

In the year 1827 a paper, by Dr. S Erdmann, of Leipsig, "On Nickel, and obtaining it," attracted much attention, and soon after Dr. E. A. Gertner, a chemical manufacturer at Schneeberg, succeeded in producing an alloy of copper, zinc, and nickel, of excellent colour and quality, to which he gave the name of "Argentan." Although after Kronstadt's discovery attention was generally directed to utilise the new metal, and various alloys introduced, under the names of white copper, semi-argent, new silver, &c., the extent of manufacture was quite insignificant previous to about the year 1830. About that time the refining of nickle was first introduced into England by Mr. P. N. Johnson, of Hatton Garden; and soon after Mr. Hallett, of Broadwall, London, commenced the refining of Nickel. At this time the price of nickel was 4s. 6d. per pound. The nickel of commerce was up to this date very intractable for all the purposes of manufacture, except for casting. Spoons, forks, &c., were until this date mostly cast in sand. About the year 1832 a great improvement took place in the refining of nickel. Mr. Askin, at that time following or studying the profession of a veterinary surgeon in Birmingham, had occasion to visit several parts of Germany on business, and having a good knowledge of chemistry, he became acquainted with certain facts relative to the refining of nickel, which led him to devote special attention to the subject; and on returning to Birmingham he succeeded in refining nickel by a purely chemical process—he dissolved the metals, left the nickel in solution by precipitating the impurities, and then threw down the nickel as oxide. For a short time he was in partnership with Messrs. Merry, to carry out his discovery, but the partnership was subsequently dissolved, and Mr. Askin associated himself with Mr. Brook Evans, under the firm of Evans and Askin. The German silver trade rapidly extended in the year 1840, or thereabouts. The process of electro-plating and gilding first began to develope as a successfu manufacture chiefly under the auspices of Messrs. E kington. This gave a powerful impulse to German silver manufacture, which, from its great beauty and durability, soon superseded the old plated copper; and it had the great advantage that whereas copper must always be stamped or spun at a lathe, German silver can be either cast or wrought into a finished design of any article before plating.

Nickel and cobalt, originally found at only a few mines in Sweden, Norway, and Germany, are now found in almost every mining district both of the Old and New World. It may be observed that although the ores of Norway and Sweden are not very rich, they by their abundant supply contribute very largely to our nickel manufacture. One of the most promising nickel mines is at Canton Valais, in Switzerland, but it is now nearly closed. As a rule the mines are not worked for nickel alone, but as an adjunct in mining for other minerals. The price of the metal has varied considerably. In 1840 it was 4s. per pound; in 1849 it had risen to 13s. per pound (?); but it has since gradually come down, until its present price is again 4s. 6d. Commercial nickel, although sold in ingots like the malleable metals, will not roll. The difficulty of obtaining it quite malleable, which it is when chemically pure, has, perhaps, been a cause of its being only hitherto employed as an alloy (German silver), which is composed, according to the requirements of the manufacture, of various proportions of nickel, copper, and zinc. Intimately associated with the refining of nickel is that of cobalt, as they are very generally found together in their ores. Cobalt has been used in the impure state as zaffre, for imprinting the intense blue of porcelain and the better kind of pottery, from time immemorial. About the year 1840 Mr. Benson, of Birmingham, succeeded in refining cobalt by a purely chemical process; however, he had scarcely brought his discovery to perfection at the time of his decease. It was afterwards completed and carried out by Mr. Askin; and Messrs. Evans and Askin continue up to the present time the chief makers of the oxide, that being the state in which it was now used. In 1844 the price was 40s. per pound, but it has been gradually reduced until now it is only about 12s. The number of persons employed in the nickel and German silver manufacture is—in Birmingham, 7,000; and in Sheffield, 5,000; this includes, of course, the manufacture of the various articles in which German silver is used. This production of refined nickel at this time is about 200 tons per annum, equal to about 1,200 tons of German silver.

PHOTOGRAPHY.

Direct Carbon Process.—We have received, from Matthew Firling, of Dorchester, whose interesting experiments in carbon printing we have before noticed, two examples of direct carbon printing, with very excellent half tone, gradation, and vigour, one of them being an especially fine print. Regarding them he says:—"I have for the last twelve months past been trying to find some plan by which the carbon process might be worked without re-mounting before developing or transferring to bring the print in its proper position, and I am glad to say that, after trial upon trial, I have succeeded in obtaining a perfect direct carbon printing process, and which is so simple that it can be worked with astonishing ease, and, I think, cannot help being made a commercial thing of in course of time. It is based on the use of a bichromate collodion. I have sent you two prints, but they are not quite so good as I should wish them, but I will try and send some better shortly."

Photography and Book Illustration.—We understand that Mr. A. W. Bennett is about to add to his series of "Photograghic Gift-books" an edition of Scott's "Marmion," and a work by Mr. F. G. Stephens entitled "Flemish Relics, Architectural, Legendary, and Pictorial;" also two smaller works on the "Ruined Abbeys and Castles of Yorkshire," and "The Border."

Lunar Photographs.—We have received from Mr. A. Brothers, of Manchester, an exceedingly fine series of photographs illustrating the various phases of the recent eclipse of the moon, and further details regarding them, which will appear in our next.

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CHEMISTRY.

Manufacture of Arsenic Acid.—Girardin suspends powdered arsenious acid in water, and passes chlorine into the mixture, by which he soon obtains a clear solution of arsenic acid in hydrochloric acid. By evaporating this solution a mass of arsenic acid containing no trace of arsenious is procured. As it is difficult to keep any considerable amount of arsenious acid in suspension in water, the author finds it better to make a saturated solution of that acid in hydrochloric, and pass the chlorine into such solution while hot. The stream of chlorine is stopped when a little of the fluid neutralised with potash no longer gives a green precipitate with bichromate of potash, thus showing that all the arsenious acid has been converted. The hydrochloric acid may then be recovered by distillation, and the syrupy solution of arsenic acid left in the retort evaporated.

Alkaline Metals and Pyroxyline. — Some curious reactions of the alkaline metals upon gun-cotton have recently been discovered, which may possibly throw some light on the decomposition in collodion which takes place when the salts of these metals are present: the facts have been pointed out by Mr. W. S. Scott. In some of his recent experiments he accidentally dropped a piece of potassium upon some gun-cotton lying upon his laboratory table, and was surprised to see that the gun-cotton immediately exploded. He then instituted a series of researches to determine what conditions were necessary for the explosion to take place—whether the phenomenon was the result of moisture; whether other metals would act similarly, &c. He found that, notwithstanding all his precautions to prevent friction, the gun-cotton still exploded. When sodium was employed a like result followed, though the gun-cotton had been rendered perfectly anhydrous. When an amalgum of sodium and potassium was used, no apparent result was produced. Various other metals were experimented with, but decided effects were obtained only with the metals of the alkalis. One of Mr. Scott's discoveries is the fact that when metallic arsenic is mixed with gun-cotton, a blow of the hammer is sufficient to ignite it.

Aventurine. – The composition of Venetian aventurine or avanturine, a vitrified substance containing specks of gold, so much used for brooches and other ornaments, remained for a long time a secret, but two chemists, MM. Fremy and Clemandot, discovered a method of producing it. Their method was to fuse together and keep heated for twelve hours a mixture of three hundred parts of pounded glass, forty parts of protoxyde of copper, and eighty parts of oxyde of iron, and then to allow the mass to cool very gradually, and in this manner they obtained fine specimens of this artificial precious stone. F. Pelouse, another French chemist, has just communicated another method to the Academy of Sciences; he takes 250 parts of fine sand, 100 parts of carbonate of soda, 50 of carbonate of lime, and 40 parts of bichromate of potass. The glass or enamel thus obtained contains from six to seven per cent. of oxyde of chromium, of which about half is combined with the glass, while the rest remains free in the form of those brilliant metallic specks which give the peculiar character to the composition. The Parisian lapidaries who have operated on this new material, give a very favourable account of it as likely to furnish an important material to the jeweller's trade; it is said to be equal to the finest old Venetian aventurine, the metallic lustre of the enclosed specks being very brilliant, and the composition so hard that it will readily scratch and cut glass, and, consequently, is susceptible of a very high polish.

REVIEW.

Tables of Tangential Angles and Multiples, for setting out Curves from 5 to 200 radius. By Alexander Beazeley, M.I.C.E. London: Lockwoods.

This is something new in the portable line—suited for carrying in a strongly made waistcoat pocket, nicely got up and printed, but liable to get into confusion. This, however, is compensated for by the fact that the hands are set at liberty in using the theodolite, as the card can easily be placed thereon. The tangential tables, and their differences from 360°, are given for chords of the same denomination as the radius; then, when the unit of radius is a chain, the chords also are a chain in length, and so for other denominations. Curves of less than 15 chains radius should be set out in half chain chords, for which the tangential angle for chain chords of double the radius must be used; but the chords of these small radii are given for cases in which great expedition, and only approximate accuracy are required. On the whole, we are inclined to think that the pocket tables will become favourites in surveying, if they are not so already.

GENERAL NOTES.

Important Mineral Discovery in Yorkshire.—A thorough investigation of the district between the village of Lofthouse and the Wernside Mountains, has just been made, the result being the discovery of encrinitic grey, black, and other marbles, which had been found in layers to the extent of upwards of 30 feet in thickness, and covering an area of about 10 square miles. They are within 2 feet of the surface, and so abundant and exposed are they that the rocky channel of the River Stean is entirely composed of marble. The river is choked with huge blocks of the material, and its precipitous marble sides, which are polished by the rushing winter floods, are filled with encrinitic and other fossils, which peer out in countless myriads along the solid marble faces of the cliffs which hedge in the river. The district is also rich in ordinary limestone, beautiful freestone, lead ore, ironstone, and coal.

Discovery of Oil in the Cleveland Hills.—In the Cleveland iron district large iron royalties have recently, we understand, been leased by several enterprising capitalists, including Mr. George Elliott (of Houghton), Sir Charles Fox, Mr. Murray (contractor for the Portsmouth fortifications) Mr. H. K. Spark, &c., who purpose erecting blast-furnaces upon the ironstone, as from calculations made by Mr. J. G. Beckton, engineer, Whitby, it is ascertained that pig-iron can be produced at 3s. per ton cheaper in this manner than by covering ironstone to meet coke and coal. A most important discovery has lately been patented by Mr. Beckton, which will render the Cleveland district still more celebrated. He proposes to extract oil (similar to the American petroleum) from the shales found above the ironstone. Some of these shales will yield 25 gallons of oil per ton, and the oil can be produced at a cost not exceeding 6d per gallon. Works are now erecting at Grosmont to work this valuable patent in connection with the blast-furnace of Messrs. Bagnall.—*Newcastle Daily Chronicle.*

The hundred-thousandth part of a grain of gold may be seen with the naked eye.

In sandy soils, the greatest force of a pile engine will not drive a pile deeper than 15ft.

The relation of the light of the .un to Sirius is as eleven or twelve million to oness

At the gold mines near Halifax, N. S., 1,200 ounces of gold per month are taken out.

It has been stated that potatoes placed in steam boilers will prevent incrustation.

PATENT LIST.

(From the Commissioners of Patents' Journal.)

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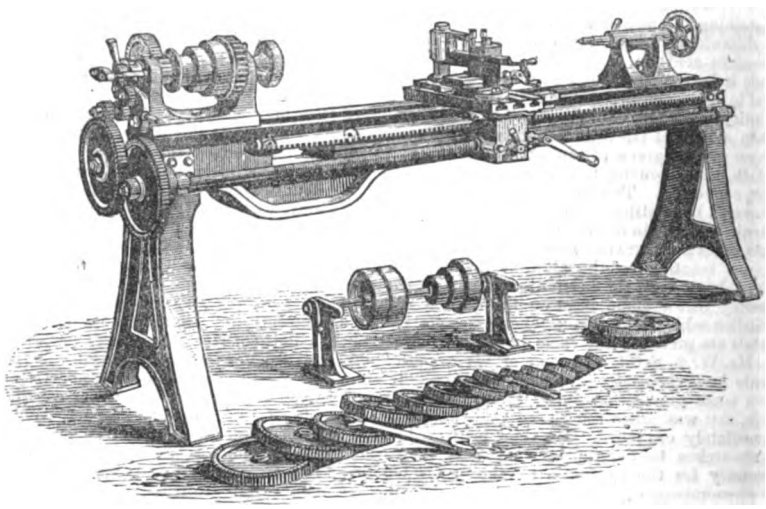

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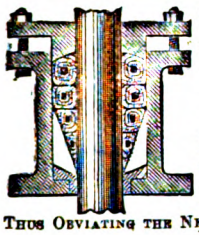

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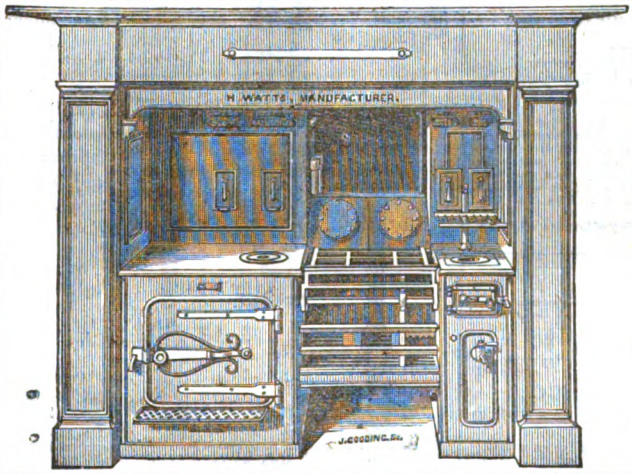

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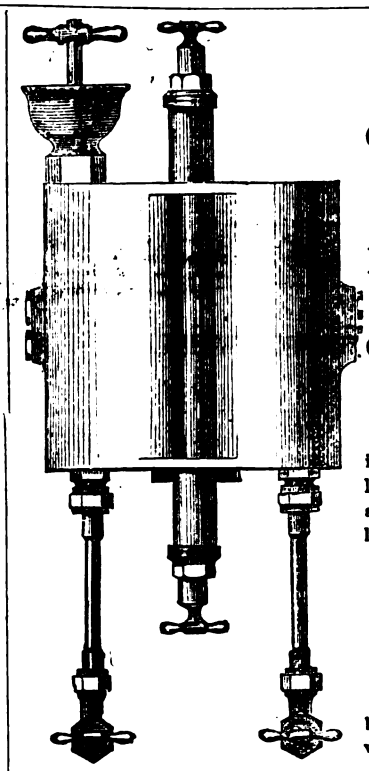

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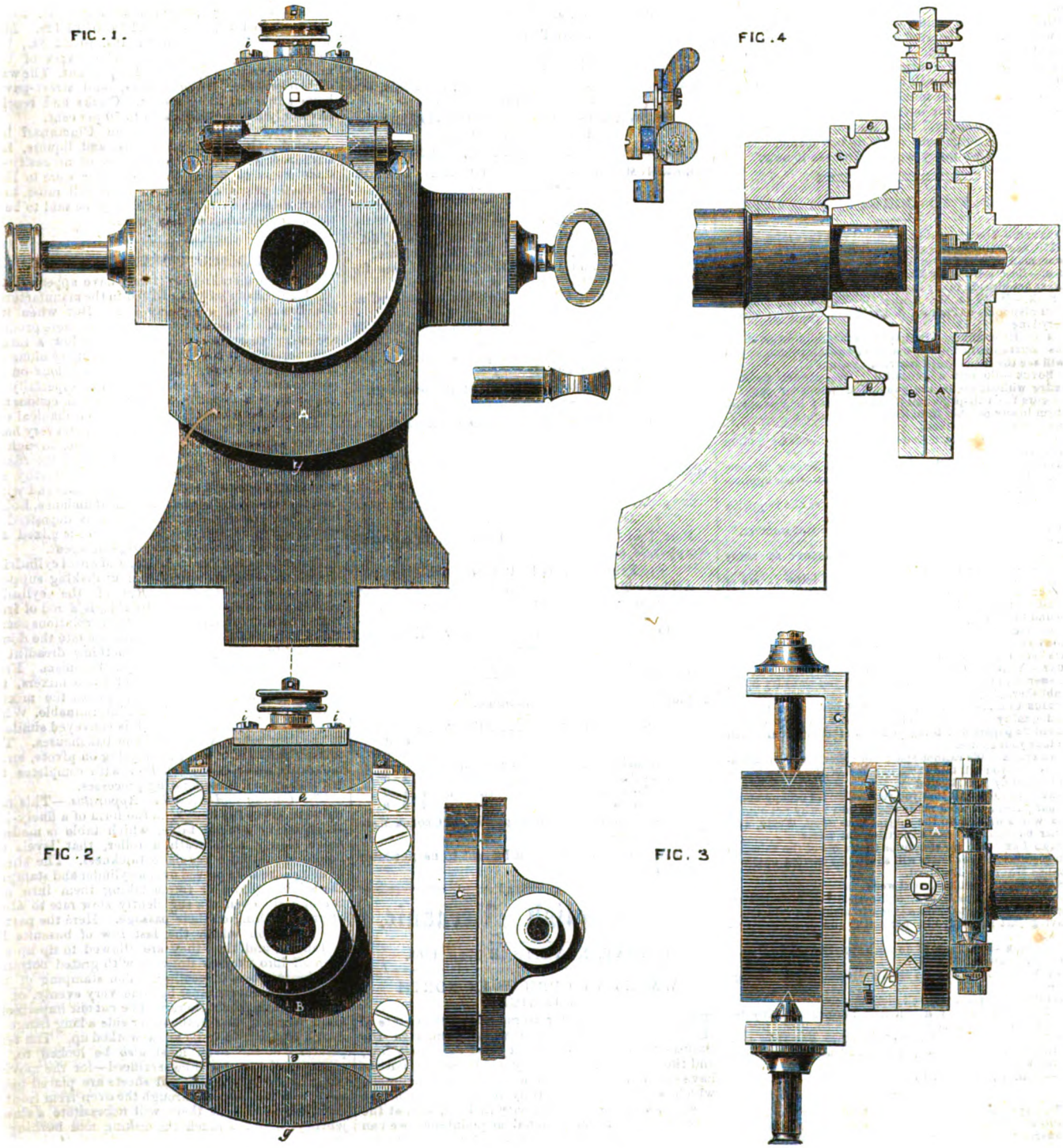

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HENRY MORTON.—All that you require would occupy many of our pages and need many engravings; why not obtain the works written on the subject from Spon, Weale, and other booksellers. See advertisement pages.

EDWARD LEE.—We are of opinion that most of the valuable suggestions in your letter will shortly be carried out.

CHARLES MORTON.—Received.

T. S. MERRIT.—Fret saw, next week.

VELOCIPEDE.—James Hearn, of North-street, Manchester-square, is willing to assist any one in making a velocipede having just succeeded in perfecting one to his satisfaction.

WM TAYLOR.—We know of no such society.

J. S.—Write again.

JAMES W. IMESON.—Write to Messrs. Holtzapffel, 127, Long acre.

MAGNETISM.—Explain yourself more clearly.

Z. Y. X. Search back, you will find the process fully descibed in a recent number.

COUNTRY BUILDER.—We know of no other way than consulting the advertisement pages of the trade journals, and acting with caution

C. B.—Thanks; attended to.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c. If they don't like to see their own names paraded, use those of an ancient or any other man.

Several letters remain over till next week for answer.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

NOTICE TO ADVERTISERS.

ADVERTISERS in this journal are respectfully informed that the Collector from the office, 162, Fleet-street, will call upon them for a settlement of the amounts due for the insertion of advertisements. The Collector will in every instance hand in a printed receipt for the sum paid to him. Advertisers are particularly cautioned against paying money without receiving the printed receipt.

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All Advertisements should be sent to us not later than Friday.

The English Mechanic.

FRIDAY, NOVEMBER 17TH, 1865.

WAGES AND PRICES IN NORTH AMERICA.

IT is a difficult matter to get at the true state of the case, as regards the working man in the States—the details vouchsafed being extremely few, and the dates of their delivery far between; but we have been favoured with a list from Cincinnati, which seems to be a carefully prepared comparison of wages and prices in that city in 1860, and at the present time. From personal acquaintance we can speak to the truth of much of it. Now, as Cincinnati is a large city, making excellent progress, it probably admits of being looked upon as giving the average of the country. As a rule, the advance of wages in private employ has been 100 per cent., but much less in public and company service. Machinists, who earned from £1 16s. to £2 8s. in 1860, now earn from £3 4s. to £4. The rate for locksmiths has advanced from £1 16s. in 1860, to £3, and £3 12s.; whilst painters who got £1 16s. in 1860, now get on an average £4 4s. Tailors used to make coats at £1 6s. to £1 8s., now they get £2 16s. They made vests and trowsers at 7s., and now get 13s. 6d. Cigar makers, in 1860, got from 18s. to £1 4s. per 1,000; now they have £2 16s. Bricklayers, who got 8s. to 10s. per day, previous to hostilities, now get 18s. to £1. Carpenters, who got 7s. to 8s., now get 12s. to 16s. The wages of plasterers have advanced from 5s. or 6s. to 12s; and of hod-carriers, from 4s. or 5s. to 12s. Gunsmiths now earn £3 12s. to £4 per week, though in 1860 the best of them only received £1 16s. to £2 8s Bookbinders have also risen in value; women who got 14s. to 16s. per week in 1860, now get £1 8s. to £1 12s. Men's wages, which were from £1 16s. to £2 8s., have risen as high as £3 to £4. The wages of bootmakers have risen fully 75 to 100 per cent. The wages of blacksmiths, boiler-makers, and street-pavers, have advanced 100 per cent. Clerks and teachers have only advanced from 25 to 50 per cent.

Turning to prices—rents in Cincinnati have doubled. Groceries, provisions, and liquors, have advanced more than other articles of necessity—in some items to thrice the price they were in 1860! If these prices are inflated their fall must bring down wages: so that things may be said to be on the average, much as they were.

THE BISCUIT MANUFACTURE.

TO the general reader it may have appeared that hand-labour only is utilised in the manufacture of the Biscuits, of every-day life. But when it is considered how many thousand tons of these products are every year consumed, and at how low a rate of remuneration, it is evident that machinery alone can accomplish the task. It would be invidious on our part to mention any particular firm as especially engaged in this department of industrial commerce; but it may be taken for granted that mechanical contrivances are here largely introduced, on every hand. All the appurtenances of extensive trade, in such establishments, are visible externally and internally, and the realities do not fall short of a worthy and honourable comparison. There are cranes and windlass, labour-saving contrivances in abundance, hoists, lofts, bake-houses, &c. The flour is deposited by steam, sifted by steam, and the sugar is mixed and pulverised by the same indefatigable agent.

The mixers are in a high loft, and are of cylindrical shape, standing on strong and unshaking supports of solid iron. In the centre of the cylinder, running through from side to side, is a rod of iron, armed with huge knives, and as the revolutions occur, these knives chop and cut, and incorporate the dough thoroughly. They appear something dreadful in their revolutionary garb of sharp antagonism. From the floor above, to the centres of these mixers, the dough with water is conveyed; and so the mixing is made complete, effectual, and interminable. When in proper condition, this dough is conveyed similarly to the floor below, where are the bakehouses. The mixing pans are of metal, revolving on pivots, and a moveable roller connected therewith completes the triturating and incorporating processes.

The Cutting and Stamping Apparatus.—This machine receives the dough, in the form of a finely-laid sheet, on to a metal table, which table is made to move slowly underneath a roller, that levels the dough-sheet to the requisite thickness. The sheets of dough are then passed over a cylinder and stamped, the sliding plane or frame taking them into and through the oven at a sufficiently slow rate to allow of proper baking on their passage. Here the part of the frame on which the last row of buscuits lay is hinged, and thus they are allowed to tip up and drop off into shallow drawers with grated bottoms, for the purposes of cooling. The stamping of the huge dough sheets must be done very evenly, or on one side of the sheet there will be cut out imperfectly sized biscuits, and on the other side a long fringe of dough will remain to be anew worked up. The temperature of the oven must also be looked to, or economy of speed will be sacrificed—for the moving plane on which the stamped sheets are placed being always on the journey through the oven from front to back, too little heat there will necessitate a slower journey, and too much the baking and burning of the product.

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The cracknel-making apparatus is a round boiler, full of hot water, into which the stamped dough cakes are thrown, whence they are removed to the baking pans, thence to the ovens, coming out subsequently in their characteristic form.

We are favourable to the introduction of machinery in these hand-making processes, on account of the cleanliness thereby secured, and the accuracy therein demanded. The human hands, in the biscuit manufacture, have very little to do except to attend to the machinery. The dough is made, mixed, spread out, stamped, passed through in the oven, in shape, nicely browned and baked, delivered at the back of the apparatus in fit eatable condition, with a speed and accuracy most surprising. The quality is also as superior as the appearance.

THE SILVERED GLASS PROCESS.

WE are not about to divulge trade secrets, but merely to narrate what may be interesting to the uninitiated, and to the general reader.

The apparatus necessary in the silvering-glass process are, first, a beautifully level slab of iron, or steel, placed over a huge oven, heated by gas or in other suitable way, and supplied with all the means for gradual cooling. Now, suppose, we need to silver over a flat surface of plate glass; we shall cleanse it well with filtered water and a chemical solution, and then place it on the heated iron slab, before referred to.

A solution of nitrate of silver (in colour as pure water), in combination with a reducing agent, of which the character and composition are secrets, is now poured carefully and evenly over the surface of each sheet of glass—as a photographist disposes of his developing and sensitizing solutions, while the attendants watch the effect of the heated slabs. Soon the nitrate of silver, acted on by the reducing chemicals through the medium of heat, begins to deposit itself slowly and evenly on the surface of the glass sheets; and when these are covered with a coppery hue (this being the then appearance as they lie on the iron slab), they are poised up on one end, rubbed down gently with a kind of rag brush, note being taken of all defects in the deposition of the silver—for there are sure to be some after the laying on of only one solution—and then lifted off the slab to be dried. These handlings require much care; for the sheets, although of great thickness, frequently fly in all directions from no apparent cause, and considerable loss of profit is the result. When dried, the plates are treated to a repetition of the silvering and other processes, and are then worthy the critical examination of the most fastidious. The undimmed splendour of the glass is perfect; its silvery hue not to be approached by any other reflecting medium.

But glass is a little more difficult and expensive in its mode of operation, as moulds have to be made to suit the needed curve. The glass-sheet must be well and evenly supported in every part, or it is liable to fly in a moment, and great expense is often caused by such contingencies. So, in the curved products, the solution is more difficult in the laying on, and the expense is greater, but the effect is exquisite. The silvered-glass is backed up by a kind of red paint, that will not wash off or wear away, and its production is a great secret in the trade. To resist damp and wet in the "backing-up" is a *sine qua non* in this manufacture.

This glass-silvering, as is apparent, may be largely and most advantageously used for decorative purposes. In these days of competitive industry, it is no slight advantage to have a mode of adornment elegant and not too expensive; and our "building" friends may perhaps devise way for the use of silvered glass at present unknown to fame. Already it darts light upon our darkness, multiplies our illuminative power, seemingly extends the confined area of modern shop-erections; and may perhaps in the future be as largely used for exterior elaboration. It is a process that may not even yet be perfect.

REVIEW.

The Slide Valve Practically Considered. By N. P. BURGH, Engineer. London: Spon, Bucklersbury.

This is a book which, from the examination we have bestowed on it, we consider it would be well were it in the possession of those who have to design and fit engines; for of all the details of an engine that of the slide valve is the most important. Its defective action impedes the progress of the whole; hence the necessity to producers, of having a handy reliable work at hand such as this is. The book, says Mr. Burgh, is intended to enable the student and interested observer, to clearly understand the use and action of the detail in question. The rules relating to the equilibrium slide valves, have, he states, been carefully digested, and judging from what we have seen, the statement is perfectly correct. The following recommendations we willingly endorse:—"The delineation of the eccentric circle should be well studied, it being remembered that from it the slide is proportioned. The angles assumed by the cranks at given grades of expansion are too often disregarded by the pupil and young engineer. It is not usually appreciated that the arc passed through, determines the lap of the valve. In no case whatever should a valve be designed without first considering the direction of the crank pin, and the amount of expansion required. The proportion of lap to width of opening or port can only be obtained by the means alluded to. The lead of the slide valve has been duly considered. The author would impress that the true versed sine and radius of the arc of supply steam can only be attained, by *noticing the lead.*" The time for supply, expansion, exhaustion, and compression has been fully explained, so that its value and defects will be apparent. The delineation of the crank axle has met with due attention, and will be found of utility in proving the actual consumption of the steam at each stroke of the piston. Furthermore, it may be stated that Mr. Burgh has carefully avoided theorizing on his subject; all his remarks have been deduced from practical demonstrations—assumptions have not been admitted—therefore the data will be found exact. There is a handy excellent index appended, which will be found of great assistance by the reader and student. The illustrations are boldly executed, and quite sufficient for their purpose. By the way, there is a chapter—not by any means the least in importance—of "General Observations," which will be found very suggestive and handy by many. We regret much that we have not room to spare for a more extended review, illustrated from the examples given by Mr. Burgh.

SWEDENBORG.—No. IV.

(*Concluded from page* 79.)

CONCERNING the translatory motion of the stars along the Milky Way, no conjecture had been formed anterior to the publication of Swedenborg's theory. In his statement, our author says:—"The common axis of the sphere or sidereal heaven seems to be the galaxy where we perceive the largest congeries of stars. . . . The solar or stellar systems afterwards proceed from the axis, and inflect themselves in different directions; but that, nevertheless, all have reference to that axis. . . . . the largest congeries is the Milky Way . . . . *here* lies the chain and *magnetic course* of the whole of our sidereal heaven." This part of my subject may fitly be closed with the following extracts from the "Principia," which have been amply "facted" by the joint labours of the two Herschels and Lord Rosse:—"That one vortex, with its votive centre, constitute . . . one mundane system; that several vortices, with their centres, form together a certain sphere; that a sphere, consisting of many vortices of the same kind, has its own proper figure. . . . That the whole visible sidereal heaven is one large sphere, and that its suns or stars, together with their vortices, are parts of a sphere connected one with the other, in the manner we have mentioned. . . . That there may be innumerable spheres or sidereal heavens in the finite universe; that the whole visible sidereal heaven is, perhaps, but a point in respect to the universe. The sidereal heaven, stupendous as it is, forms, perhaps, but a single sphere, of which one solar vortex constitutes only a part. Perhaps there may be innumerable other spheres, and innumerable other heavens similar to those we behold: so many, indeed, and so mighty, that our own may be respectively only a point" To me, there is something very grand in these few last lines.

Some eleven or twelve years since, the work by Reichenbach, entitled "Physico-Physiological Researches on the Dynamics of Magnetism, Electricity, &c.," created quite a sensation. In that work we are presented with many engravings, showing the actual flame which goes forth from the ends of magnets, and from all sides of them, also from the human hand, body, &c. Reichenbach discovered these flames by partially clairvoyant subjects, when shut up in a dark room. The flames proceeding from the poles of a large horse-shoe magnet, capable of supporting 90lbs., were described as about eight inches in length, mingling with irridescent colours, flickering and waving, yielding when blown upon, &c. Various experiments with other bodies are also here detailed, and the force which enveloped these flames is called the "odyllic" force. To say the least, it is interesting to observe in Swedenborg's "Principia" precisely *similar* drawings, illustrating the *same* sphere around magnets and around iron. Reichenbach demonstrated the existence of these spheres as magnetic *flame* and *light*, by means of his patients or subjects. Swedenborg has similar drawings, illustrating precisely the same thing, all but the flame; and as the spheres include the flame, though not seen, the coincidence is interesting. Space there is not for any of the drawings, but a few of our author's remarks may be quoted. "By reason," he says, "of the connection between the vorticles which extend from one pole to another, and of the formation of the sphere, there exist poles, one on each side of the magnet: there exist, in like manner, polar axes extending in the sphere to a distance from the magnet; and these axes do not receive their determination from the magnet, but from the sphere and its figure. That not the magnet, but the sphere, forms the polar axis on each side, is evident from this circumstance—that the polar plane passes through the magnet from one side to the other, as in [figure] where the whole [of one] side is polar, as is also the opposite side, and the elements of the effluvia travel within the mass rectilinearly . . . . according to the interior texture. Hence the polar axis cannot have any fixed place in the magnet, but the place and situation of the poles are owing entirely to the sphere, which is compelled to encircle the magnet according to the figure of the latter. . . . . By the application of two or more magnetic spheres, the figure of each is immediately changed: from two or more arises one that is larger; and the whole of the distance between the spheres becomes an axis." (A comparison here with Reichenbach is curiously interesting.) "The sphere of the effluvia around now extends itself to a considerable distance, so that the vorticles or gyrations of effluvia emit themselves like radii on every side, and dispose the magnetic element itself into the same situation, whence the magnetic element regards the iron as its pole or centre from which the vorticles issue in a long series. Not only does a tide of effluvia perpetually emanate from the iron, but it also constipates and surrounds its surface—a circumstance so evident, and from so many phenomena arising from the conjunction of the magnet with magnetic needles, as to be placed beyond a doubt."

In 1734, in his forty-sixth year, our author published his "Philosophy of the Infinite, or Outlines of a Philosophical Argument on the Infinite, and the Final Cause of Creation; and on the Intercourse between the Soul and the Body." This and the "Principia" gave Swedenborg an European reputation, and his correspondence was eagerly sought after by such learned men as Wolff, Flamstead, Delahire, Varignon, Lavater, &c., and in December of 1834, the Imperial Academy of Sciences at Petersburg appointed him a corresponding member. At this time he was a diligent student of Wolff's philosophy; and whoever compares the writings of the two, will find an immeasurable superiority in those of our author.

From 1734 to 1736 he remained at home, and during this interval he conceived the project of his great physiological works. In the latter year he obtained leave to travel, to gather matter for their completion, and went through Denmark, Hanover, Holland, visiting Antwerp, Brussels, Rotterdam, &c., and in 1738 arrived in Paris. As a characteristic of our author, the following is valuable, taken from his note-book, wherein it was entered during his sojourn in Paris:—"My walk [in the gardens of the Tuileries] was exceedingly pleasant to-day; I was meditating on the forms of the particles in the atmosphere." Leaving Paris in 1739, he crossed the Alps into Italy—passing through Turin, Venice, Verona, Mantua, Milan, Genoa, Florence, Pisa, and entering Rome in the fall of the year. It is stated that, while at Rome, he published two dissertations on the nervous fibre and the nervous fluid, one on intermittent fever, and several others; and there is no doubt but that previous to these he had finished his "Economy of the Animal Kingdom," published at Amsterdam in 1740-41. This work is in three parts—the first on the blood, blood-vessels, and heart, with an introduction to rational psychology; the second on the animation of the brain synchronous with the respiration of the lungs, on the cortical substance of the brain and the human soul; the third treats principally of the human fibres, and expounds the various manner in which the beams and timbers of the body are laid, especially the construction of the frame—somewhat as the "Principia" unfolds the elementary construction of the universe. It also considers the different kinds of fibres, the form of their fluxion, and the doctrine of forms generally; and lastly, in a masterly manner, the diseases of the fibres. In the weightiness of its truths, in sustained order of exposition, in felicity

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of phrase, and in finish and completeness, it is not surpassed by any scientific work that the author published. It is utterly impossible to devote space to an analysis of this great book, but room can be made for an extract from a critique in "The Forceps," a London periodical, well known some twenty years ago:—"This is the most remarkable theory of the human body that has ever fallen into our hands, and by Emmanuel Swedenborg, too!—a man whom we had always been taught to regard as either a fool, a madman, or an impostor, or, perhaps, an undefinable compound of all the three. Wonders, it seems, never will cease, and, therefore, it were better henceforth to look out for them, and accept them whenever they present themselves, and make them into ordinary things in that way. For thereby we may be saved from making wonderful asses of ourselves and our craft, for enlightened posterity to laugh at. What has the world been doing for the past century, to let this great system slumber on the shelf? . . . It is clear that it yet knows nothing of its greatest men. . . . Swedenborg's doctrine is altogether the widest thing of the kind which medical literature affords, and cast into an artistic shape of consummate beauty. The book is a perfect mine of principles, far exceeding in intellectual wealth, and surpassing in elevation, the finest efforts of Lord Bacon's genius." The praise is every whit deserved.

Then we have treatises following, on the brain, en generation, on the ear and hearing, on the human mind, and on common salt. I would add, just as a fill in, that in 1852, the Royal Academy at Stockholm had its annual medal struck in memory of Swedenborg, the eulogium on whom was delivered by the President, General Akrell.

Here, it appears, must close my review of Swedenborg as a man of Science; into the realm of theology I may not enter, though I doubt not many of my readers will feel disposed to learn what so great a man has to say on what is rightly considered in our day a most important matter. Should any feel so disposed, I, standing at the portal now, may assure them that what lies behind the veil is greater than that laid open in these pages. Respecting his work as a man of science, it is proper to add that he was not so much a collector as he was a systematizer of facts, and a discoverer of their hidden causes. "Many," says he, "stubbornly refuse to stir a single step beyond visible phenomena for the sake of the truth; and others prefer to drown their ideas in the ocult at the very outset. To these two classes our demonstration may not be acceptable. For, in regard to the former, it asserts that the truth is to be sought for beyond the range of the eye; and in regard to the latter, that in all the nature of things there is nothing but is either already the subject of demonstration, or capable of becoming so."

From the time at which we have left him, until his death in Great Bath-street, Coldbath-square, London, on the 29th March, 1772, he was almost solely engaged in his theological works, by which, at the present day, he is best known. He occasionally travelled about ere his body found final rest in the Swedish churchyard, Ratcliff-highway. In person Swedenborg was about 5 feet 9 inches high, rather thin, and of a brown complexion. His countenance always bore a cheerful smile, which added a charm to its expressiveness, and his general appearance was dignified and venerable. I will conclude by quoting the words of the Rev. O. Prescott Hiller:—"As he becomes more known, surprise and admiration take the place of neglect and contempt; the earnest searchers for truth wonder that they had not been directed to this light before, and the intellectual and the learned are astonished that they had passed by a thinker and writer who far excells them in intellect and learning."

I may add that my authorities are a "life" by Rich, unfortunately out of print now, one published by O. Clapp, of Boston, U.S., in 1854; Whyte's "life" (Pitman, Paternester-row), but principally the works themselves, to be had from Mr. Alvey, Bloomsbury-street, for whose kindness, and for the portrait which accompanied No. 1, I have to return my thanks. The works themselves, all things considered, are published at a very low price. Brief and disconnected as this compilation has, almost of necessity, been, I trust it may have done something towards creating an interest in the writings of Emmanuel Swedenborg. E. C.

THE produce of the New Almaden mines for the last ten years has averaged about 2,500 flasks of 76½lb. each of mercury per month.

THE total value of the minerals obtained during 1864 was £31,603,047, the value of the metals produced being £16,281,869.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

MUCH WORK AND LITTLE PAY.

Sir,—In a commercial point of view the electric telegraph is undoubtedly the greatest blessing of the age.

I have noticed when the wires of all the companies, owing to some severe gale, have been entirely useless between Liverpool and London, that the confusion and excitement among the commercial population is not easily describable, and indeed it would for a short time entirely cause the suspension of all important business, and great inconvenience to those, whose sales, &c., depend on an early reply by wire?

I will with your permission say a few words on those individuals to whom are intrusted the secrets of the cabinet, the interest of our banking concerns, and the commercial transactions of the country generally. They are expected to be well educated and to maintain a respectable exterior, and for these requirements they receive the magnificent amount of from 16s. to 25s. per week. Now, if your readers would fancy for a moment the style of living of a clerk having a wife, and maybe two or three little ones depending upon him for support would be at the above rate of payment.

The companies pay such excellent dividends that I really think they should at least remember the source of their wealth, and the high prices of provisions at the present time fully justifies the clerks in making a complaint. If you would kindly give this room in your paper it might, at least, tend to bring about the above desired result, and I am sure you will have the grateful thanks of about 15,000 telegraph manipulators. AN OLD CLERK.

HINT TO MECHANICS.

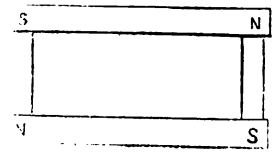
Sir,—In your invaluable work appears many articles which must be very useful and of great benefit to the working mechanic, and from which I for one have derived a great deal of information.

There is a trifling thing I wish to bring under the notice of joiners, pattern makers, and all who use a whetstone with oil, that paraffin oil is the best for that purpose; it only requires a trial, but the stone must be free from all greasy oil before it is applied. MACHANISTA.

RAYS OF THE SUN, MAGNET, &c.

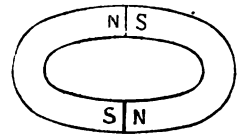
Sir,—In answer to F. Mason, the actinic rays of the sun have the effect of withdrawing the oxygen from all bodies through which they pass; consequently, the fire dies only from want of the vital element, oxygen, which is withdrawn by the actinic rays. If, however, a piece of yellow glass is interposed between the fire and the sun, it will absorb the actinic rays, and the fire will again be surrounded by oxygen, and therefore burn well.

In answer to J. B, place two pieces of steel, and connect them by two pieces of soft iron, as shown in the diagram Then rub them round with a horse-shoe magnet 3 or 4 times, always taking care to end in the same place as commenced at, they will then become magnets.



The poles will be opposite one another, as shown. If the pieces of steel to be magnetised are horse-shoe shaped, they are to be placed opposite one another in this manner, and then proceed, as for straight pieces.

Another way:—A piece of glass tube is to be introduced within a helix of covered copper wire the two ends of the wire are to be connected with the two poles of a battery. The piece of steel to be magnetised is then placed within the tube, and it instantly becomes a magnet.



PABROW HAWK.

P.S.—The condenser described by T. Stothard is only available for galvanic battery or coil apparatus.

OUR SUBSCRIBERS' NOTES AND QUERIES.

Sir,—Can any of your scientific readers inform me whether there has ever been invented a lathe that would turn either gun stocks or shoe lasts, or anything of a similar shape—that is, anything not perfectly round? An answer in your valuable paper will be esteemed a favour by NEMO.

Sir,—Can any of your numerous readers inform me how to obtain ivory black in quantities without paying the high price charged by the shops. W. SHORE.

BRONZING.

Sir,—If any of your readers can assist me by publishing through your columns a recipe for copper bronzing, the same as the different kinds of figures are done, you will greatly oblige a constant reader of THE ENGLISH MECHANIC. H. T. B.

LUBRICATING MEDIUM.

Sir,—Can any reader tell me the best lubricant for the leading screw and tin nut of a screw-cutting foot-lathe, the screw-cutting mechanism of which is not often put in use? I have been told to apply black-lead, but am afraid of its thickening the oil with which I presume it should be mixed, and that it might scour or waste the surfaces it was intended to save. IGNORANS.

INDIAN INK.

Sir,—If any of your readers could inform me of the best method of preparing liquid Indian ink, and what to put in it to prevent its forming a deposit on the bottom of the bottle, it would greatly oblige A DRAUGHTSMAN.

MONOSTEREOSCOPE.

Sir,—Will any of your subscribers oblige me with practical information, or suggest where obtainable, viz.:—how to construct an efficient "Monostereoscope." F. J. BELL.

SILVERING GLASS.

Sir,—Would you be so kind as, in your answers to correspondents to inform me how, in silvering glass, I can overcome the difficulty of having the tin-foil eaten into holes by the quicksilver before I can get the glass upon it; the quicksilver does not flow, and I have tried to spread it over the foil with my finger, but before I can get a sufficient part of the surface covered the foil splits and dissolves in several places. DON. QUIXOTE.

ENGINEER'S SCREWS.

Sir,—I should feel obliged if some of your subscribers would favour me with the number of threads to the inch (Whitworth's), for engineers' screws, say from ⅜in. up to 1 inch. ARROW.

CHEMICAL.

Sir,—I am a photographer, and of course have quantities of residues in the shape of hypo-sulphates of silver, and nitro-chlorides of gold. Can any of your readers assist me in applying them to silver plating and gilding. HEPPO.

Sir,—Can any of your readers inform me the publisher and price of one or more works on Natural Magic? THEO.

STEEL POLISH.

Sir,—Can any of your readers tell me the best way to tin glass brooches, and also how to polish and revive steel earrings and brooches that are rusty. GEO. SMITH SPOOL.

STICKING LEATHER ON TIN.

Sir,—Many thanks to Thomas Jackson for his answer on gas purifiers; could he tell what composition is used for sticking the leathers on the tin in dry meters, or where I could obtain it? VESTA.

BORING CANNON.

Sir,—Could any of your readers inform me the best mode of boring cannon, how they are adjusted upon the lathe, and what tools are used for them? YOUNG TURNER.

CEMENT.

Sir,—Could you or any of your numerous readers inform me what cement to use to fix the spindle in a plate electrical machine? CHEMICUS.

CONTACT BREAKER.

Sir,—I would feel greatly obliged to Electra, or any other person skilled in the manufacture of coils, if they would answer me the following question: Will silver do instead of platina for pointing the screw and plating the spring of contact breakers? ANSELM SPLAINE.

Sir,—If anyone will tell me how to dissolve the hard surface of cast-iron so that a file will readily cut it, they will much oblige T. H. B.

MAGNETO-ELECTRIC MACHINES.

Sir,—Will any of your readers kindly tell me the difference between a permanent and an electro magnet, such as are used in making magneto-electric machines; also, how they are made, and the sort of iron that is used in them? J. C. WIGG.

Sir,—Can any of your readers inform me what kind of tool is used to make that checked work we see on gun stocks? M. B.

FLY WHEELS.

Sir,—Could any of your readers inform me of any rule by which I can calculate the weight and diameter of fly-wheels for engines of various sizes? J. D. E.

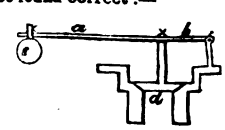
ELECTROTYPE MOULD.

Sir—Can any subscriber inform me how to make a flexible mould for electrotyping undercut work? SCIENTIFIC.

PRESSURE IN BOILERS.

Sir,—In answer to T. G. Maugh, requesting to know how to find the pressure of steam a boiler can bear by means of the safety valve—If he means the pressure allowed by the safety valve, the following will be found correct:—

$$\frac{a \times c}{b} = \text{total weight on } d,$$



which, being known, the pressure on the square inch can be found by dividing the total pressure by the area of the valve in square inches.—a = the length between weight and valve spindle; b = do. valve spindle and standard; c = the weight in pounds. G. S.

Sir,—Optical glasses in the raw state can be had of Messrs. Chance Brothers and Co., Birmingham. By sending a stamped envelope to them they will send a tarif. DAVID KNIGHT.

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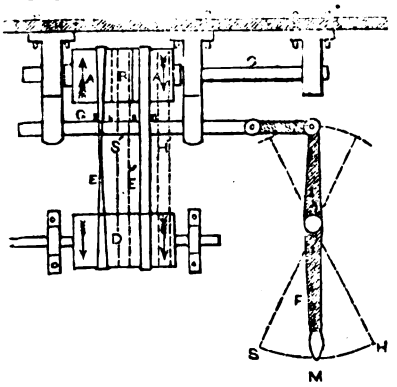
FRICTION GEARING.

Sir,—In answer to C. E. A., Sheffield, No 30, I send an inclosed sketch of friction gearing, which I think will do for the purpose he requires.

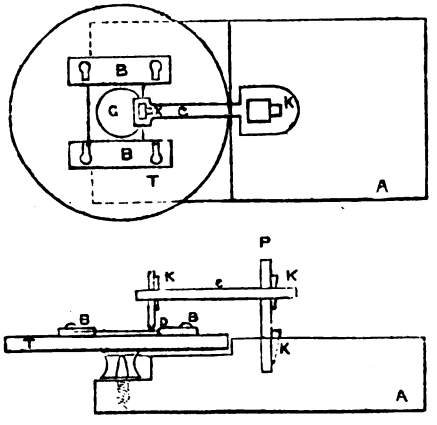


C represents the shaft of the machine to be put in motion, the drum B being fixed upon it, and the drum A, A, running loose; G is a sliding bar, with forks for guiding the belts F, F, which are driven by the drum D giving contrary motions to A, A, by one of the belts F being crossed by moving the bearer F to the point S, the belt E is brought to the position, S driving the shaft C in the direction of the arrow A, at the same time the belt E'' is moved to H'', and it is on that account that the drums A'', A'', are made twice the width of B. By putting the lever back to H'', the motion of C is reversed, and by returning to M'' is stopped. T. PARKER.

TO CUT CIRCULAR PIECES OF GLASS.

Sir,—If Mr. C. Smart has a turn table on which he mounts his objects, and a writing diamond in his possession, he has, I think, all that is required to cut the circular pieces of glass. It is only necessary to fix the square pieces of glass on the centre of the table, and hold the diamond with the right hand while he turns the table with the left.

The following diagram will illustrate all that is required:—



A, is the stand for table; T, table; P, pole fixed into stand of table; C, arm to hold the diamond; K, K, K, keys to tighten the aim C, and the diamond D; G, the square piece of glass fixed to table by the two pieces of brass, B, B, which each have two holes, so as to tighten the piece of glass G. The pieces of brass are fixed by two screws, as can be seen. These two pieces of brass will do to hold the slide on the table when required for mounting objects. DAVID KNIGHT.

Sir,—The whetstone spoken of by R. F. W. is not to be mended by the aid of cement. Let him put it in an oven for about an hour, and pour some green sealing-wax upon it while hot. It will soon be as firm as ever. C. BATHURST.

HARDENING COFFEE MILLS.

Sir,—If Give and Take, in October 18th, p. 27, will try prussiac of potash, I've no doubt he will succeed in hardening his coffee mill by making it cherry red hot. VESTA.

HYDRATE OF ALUMINA.

Sir,—J. R. may precipitate hydrate of alumina from a saturated solution of any kind of alum in water by adding a solution of carbonate of ammonia, or carbonate of soda (common washing soda will do).

IRIDESCENCE.

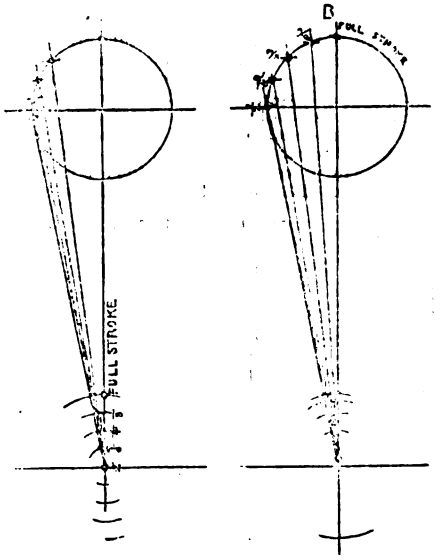
Sir,—Flanders Owen.—Indescence is produced by engraving microscopic lines, about 2000 to the inch, on the surface of metals, &c. Messrs. Barton and Co., of Birmingham, I believe have ornamented buttons and other articles in this way by a machine constructed for the purpose. When pearls are viewed through a microscope they exhibit similar lines, which reflect the light at such angles as to produce the various coloured appearance termed iridescence. Impressions of pearls taken in gutta-percha or other material is said to exhibit a similar appearance.

COLOURING GAS.

Sir,—John Turner, I think, will find it impossible to produce gases of different colours for nearly all permanent gases are colourless; chlorine, however, is an exception being a yellowish green colour.

John Clyd, No. 28 will probably find what he requires in O'Niell's "Dictionary of Calico Printing and Dyeing, price 9s. J. H. M.

Sir,—I send tracing of two diagrams showing position of piston at different parts of stroke.



In setting the slide valves of oscillating engines, should the steam cut off at ¾ stroke be taken from ¾ stroke of piston, or ¾ revolution of crank. In reference to diagrams, Fig. A shews the different points of piston divided equally, Fig. B shows position of points in path of crank divided equally. Will any of your readers explain which is right? D. T. K.

JOINING TORTOISESHELL.

Sir,—In answer to W. H. C., No. 30, Vol. II., he will find that heating the edges of tortoiseshell before the fire, and pressing them together till set, will join them strong enough for all practical purposes. J. D. E.

PISTON ROD.

Sir,—Delta does not say in No. 28, Vol. II., whether his cylinder is of iron or brass, if the latter make a double grooved piston of same material, and pack it tightly with well-oiled cotton, such as is used for wicks in spirit lamps, &c. J. D. E.

IMITATION MAHOGANY.

Sir,—X. Y. Z, p. 27, Vol. II., will find the following receipt to answer his purpose:—Boil logwood chips in water, adding a little soda or potash to bring out the colour. Apply with a brush, and use French polish when dry. For rose wood, a stronger decoction of log wood must be used, and the process must be repeated several times. To produce the fibres, put some iron filings or turnings in strong vinegar; let it stand for some years, and then brush the wood over with the solution. When dry, polish with beeswax and turpentine. J. D. E.

TO PURIFY OIL.

Sir,—E. Feather p. 40, Vol. II., may purify oil in the following manner, which is quite good enough for common watches and clocks. I have used it with every success:—Fill a phial three parts with olive oil, and hang it up in a window for six months, where it is exposed to every change in the weather. The impurities will then be precipitated. J. D. E.

DANIEL'S BATTERY.

In answer to Query, under the head of "Daniel's Battery":—

If Alfred Crofts will substitute sulphuric acid (one acid to eight of nine water) for water, which he places between zinc and porous tube, he will find his battery answer well; if not, increase size of copper suspending some bluestone vitriol in sulphate of copper solution. WM. HOSKEN.

SPLITTING SYCAMORE.

Sir,—I see in THE ENGLISH MECHANIC an enquiry as to how to prevent the splitting of sycamore to be used for rollers in the business. I have spent most of my life till the last four years; we use large quantities of sycamore for rollers and bowels from six inches to twenty or twenty-four inches diameter, and from three to four feet six inches in length. We at once, or as soon as convenient, saw the timber into lengths, and generally bore them through the centre, which appears to be the best preventative from splitting, which to me seems very reasonable. If the centre is left in, there is no space left for the wood to shrink to; but the outside very naturally shrinks as the its juices evaporate from the wood; the middle retaining moisture, does not shrink, which, resisting the shrinking of the other, causes it to crack. There may be some better method. This is the experience of thirty to forty years. J. B.

P.S.—Logwood, as a dye for mahogany, I think will not be very good. The least contact with iron will soon turn black.

ADAMANTINES.

Sir,—You can purchase the emery stick or properly called adamantines, in shape of pillar files, or round, for chamfering or reducing enamel glass or soft gebbles, at Mrs. Hitchins, watch tool dealer, Spon-street, Coventry. SPIRAL SPRING.

ASSAYING.

Sir,—H. F. will find Mitchell's "Manual of Practica Assaying," about 12s. 6d. answer his purposes.

HARDENING PLASTER.

GUSTAVUS.—Dissolve a small quantity of alum in water before mixing; the plaster will set quicker and harder.

MAGNETISM.

J. B.—From the Electro-Magnet.

ELECTROTYPE.

F. B.—Saturate with stearine. When quite dry, with blacklead (plumbago). SCIRETI

SLIDE RULE.

Sir,—In answer to Young Mechanic, in No. 30, there are instructions published for the common slide rule, price 6d. They may be obtained, I believe of almost any bookseller, or he will find a full description of it with its uses "Nesbits Mensuration." CINA.

[Next week the first of a series of articles on the engineer's slide rule will appear in THE ENGLISH MECHANIC, written by Mr. W. Tonkes.]

ELECTRICAL MACHINE.

Sir,—I beg to thank Mr. W. Hart for the promptitude and courtesy, with which he answered private enquiries respecting Winter's electrical machine. W. STRODE.

GENERAL NOTES.

A NEW DECANTER.—A very ingenious contrivance has been made by MM. Toselli and D'Allmagne of Paris. They blow a small globe within a decanter or claret jug. This globe, which has its opening at the side of the larger vessel, serves to hold a freezing mixture to cool wine or water in summer, and in winter may be filled with warm water to take the chill off Burgundy or port.

WE understand that Mr. Culverwell, the secretary to the Great Northern Railway of Ireland, having satisfied himself by a fair trial of the superior efficiency and simplicity of Captain Norton's patented railway detonators, has ordered a large supply for the Northern line. The great advantage in these detonators is, that there are no iron nipple within to rust nor copper caps to create verdigris.

ASTRONOMY.

An astronomer in the United States, in an attempt to account for the colour of variable stars, assumes that a star emitting white light while approaching the earth would, by reason of its velocity, appear to us of a reddish colour. At its perigee it would be white, changing to blue as it moved away, and becoming white again at the apogee. To illustrate his view, he finds an analogy in the whistle of a locomotive. "Here," he says, "as you approach the sound, its impulses reach you more frequently than if its source and you were at rest. At the instant of passing, you receive the normal number of impulses, and after passing the impulses reach you less frequently. The shrill shriek, the real tone, and the low roar in this case are facts which I suppose to be parallel to the red, the white, and the blue light of a star moving swiftly, first towards, and then from us."

PHOTOGRAPHY.

ENLARGEMENTS ON PAINTER'S CANVAS.—Mr. J. E. Palmer, whose photographic enlargements on canvas for oil painting we have before had occasion to speak of in high terms, referring to the method described in M. Truchelet's specification published in our last, asks us to state that he does not employ either wax, spermaceti, gum, elemi, or collodion in his method, and adds that he will guarantee them not to crack or peel from the canvas.—*Photographic News.*

COLLODIO-CHLORIDE ON CANVAS.—It will be obvious to any one disposed to try Truchelut's process of photographing on canvas, that the use of collodio-chloride of silver, instead of collodion requiring the use of a silver bath, will materially simplify the process, and probably improve the results.

VELOCIPEDE.

In consequence of not being able to get the engravings completed in time, we are compelled to defer the article on velocipedes until next week.

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THE MANUFACTURE OF COKE FROM SMALL SLACK.

The existence of immense quantities of fine coal slack in the South Staffordshire and other mining districts, in a state almost, if not quite, commercially valueless, is a fact well known to those acquainted with the coal and iron trade of this country. The fact that most of this slack, which has hitherto been considered waste, possesses all the chemical properties of the coals from which it is derived has also been some years forcing itself upon the attention of those interested, and stimulating their efforts to recombine it as a fuel suitable for smelting, and other purposes. The difficulties in the way of coking the Staffordshire slack arises from the fact that although possessing the valuable properties for which Staffordshire coal is noted, it does not possess sufficient bituminous matter to cause it to cake or bind in the process of coking. The most successful method of coking the Staffordshire is found to be by mixing with it a certain portion of bitumen, in the shape of Welsh or other bituminous slack. The greatest difficulty at present experienced is with respect to the ovens, as in those hitherto in use the heat developed in the process of manufacture is not applied with an effect or uniformity sufficient for the thorough fusion of a thick mass of slack, and the production of good hard coke. The charges are found to be caked only in layers at the top and bottom, the interior of the charge being imperfectly fused and waste.

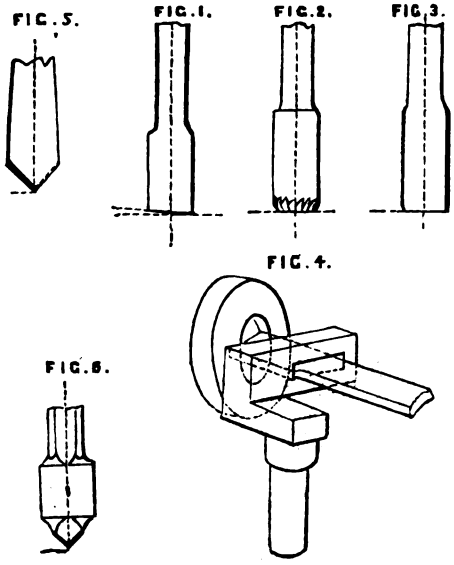
It is with a view of remedying this defect in the process that the ovens patented by Messrs. Hicklin and Pardoe have been designed. The principle upon which they are constructed is that of causing the flame and gases from each oven, in a group, to enter into a common system of flues passing over and under every oven in the series, thereby causing a thorough intermixture of the gases, the developement of intense heat, and the application of the same in a more uniform and effective manner than hitherto, the coking chambers being, as it were, enveloped in fire. It is found that the ovens will thoroughly fuse and convert into best hard coke thick charges of Staffordshire slack, with a less proportion of bitumen than is used in any other ovens, and without waste. The charges are so thoroughly fused that they are drawn *en masse*, the doors being as wide as the ovens. Any one or more of the ovens in a series can be drawn and re-charged without interfering with the others, and the charge is immediately ignited by the heat of the contiguous ovens and upper and lower flues, and in its turn contributes to the general effect. The perfect combustion of the gases (as shown by the absence of black smoke from the chimneys) developes an intense heat, which after expending itself upon a long group of ovens, is still sufficiently powerful to be applied to useful purposes, such as raising steam for working engine, and for heating and drying purposes generally.

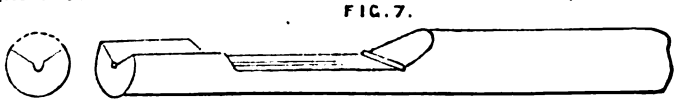
PRESSURE PISTON PACKING.

A new pressure piston packing machine has been invented by Mr. Andrew Stevens, master mechanic on the Alameda and San Leandro Railroad. Steam is admitted into the body of the piston through small valves, and by its pressure and expansive force keeps the rings steamtight against the cylinder without creating any undue friction. The valve on the steam side remains open until the pressure in the cylinder, either by expansion or exhaust, falls below that in the piston, when it closes, and the steam by its expansive force retains the rings against the cylinder to the end of the stroke, when the action is again repeated. Among the advantages claimed are—1. Absence of friction of the rings on cylinder proved by the tool marks remaining on the cylinder after six months' constant running. 2. The retension of the steam inside the piston by means of the two valves, thereby preventing waste. 3. The steam being of the same pressure inside of the piston as it is outside, the piston may overrun the counterbore without damage, and thereby prevent a ridge being formed in the ends. 4. The body of the piston fitting the inside rings keeps the piston always in the centre of the cylinder. 5. The increased ring surface, which wears much longer than narrow ones. It is not only the saving in steam and fuel which lends importance to this invention. The economy in the cost of machinery for a given amount of power must be equally great, as also the benefit to be derived from the concentration of power into small space and weight.

DRILLING AND BORING.

DRILLS used in boring works chucked on the lathe have longs hafts, some parts of which are rectangular or parallel, so that revolution may be prevented by any suitable means, such as a hook-wrench, or a spanner. The drill shaft ends are pierced with centre holes to allow of being thrust forward by the poppet-head either by hand or self-acting motion. For holes requiring great accuracy the lathe drills 1, 2, 3, are mostly used. Fig. 1 is the half-round or cylinder bit. Its extremity is ground somewhat inclined to the right angle, horizontally and vertically to the extent say of from three to five degrees. To commence, turn out a shallow recess to the diameter of the end of the bit: thus the circular part of the bit will fill the hole and be retained centrally whilst the left angle takes off the shaving. The tool noticed should not be sharpened on its diametrical face, or it would cease to be a half round bit. Generally it is made smaller behind to lessen friction; and the angle not intended to cut is a trifle blunted halfway round the curve to prevent scratching from pressure of cutting edge. The rose bit, fig. 2, has its extremity





cylindrical—a little less behind, and its end is cut into teeth like a countersink. Fig. 3 is employed mostly for cast-iron work. The blade end is made nearly parallel, the two front corners having a slight rounding and chamfered, which chamfer is continued at a lower angle as far as two diameters in the length: this part is not parallel, but slightly larged in the middle. It may, by proper direction, cut sideways, making the hole larger than intended, but when the hole has been roughly bored to its proper diameter by a common fluted drill, the bit, Fig. 3, is then placed through the stay, as shown in Fig. 4, lightly supported between the chamfer on the work and the poppet-head centre; the moment any pressure comes on the drill its opposite edges stick into the inner side of the loop, which thus retains its position. The drill and loop should be exactly central, and fig. 4 shows the common form of the stay fitted to the lathe rest; but it is sometimes made as a swing gate, to turn aside whilst the work drilled is removed. Cylinder bits may be used for enlarging holes below half an inch to a third their diameter at a cut, and from holes up to an inch to about one fourth their diameter or less: and as the size of the bit increases the proportion of cut to diameter should decrease. As the cylinder bit is not intended to be used for drilling holes in the solid material, the following course should be adopted: a drill, fig. 5, say 3-16ths diameter is first sent in to the depth of an inch or more, and the hole enlarged by cylinder bit of ¼in. diameter. The centre at end of hole is then turned by fig. 6, a re-centring tool, the plug of which just fits the hole made by the cylinder bit; the end of the drill, fig 6, then acts as a fixed turning tool, correcting the centre if not previously made true. Another short portion is then drilled with fig. 5, enlarged with the half round bit, and again corrected with fig. 6, and so on in rotation until the hole is finished. We will now notice a few other boring tools, to which time has affixed the stamp of use.

Fig. 7 is a lathe drill invented by Mr. Collas, of Paris. It is turned as a cylinder, and perforated to three or four diameters, with a hole one-tenth its exterior size. One third of the cylindrical end is removed to form a longitudinal incision extending to the centre, having radial sides; the extremity of the drill is ground somewhat as in Fig. 1, to make the one edge cut; behind the angular part a further portion is reduced to the diametrical line; the remainder is either square or cylindrical, and ends in a poppet-head centre. A shallow recess having been turned out to allow the end of the bit to be inserted, the bit bores the hole in the solid metal to the depth required. Mr. C. Holtzapffel's boring bit, with changeable cutters, derived from the half-round bit, was contrived for boring holes, so as to avoid the expense of the long boring bits required in boring models of guns, &c.

The work is made as in Fig. 8, and detached as Fig. 9. The stock end is made cylindrical, with a notch across the extremity extending below the diametrical line, also a longitudinal groove on the under side. The notch receives the cutter *c*, which takes the flat edges of the stock, and is held by two screws; the groove takes the bearing piece *b*, which also is fixed by screws, countersunk. The outer parts of *b* and *c* are turned cylindrical and hardened, the cutting angle *c* being allowed to be always more prominent than the two other parts. Holtzapffel made one stock thus, to serve for various diameters from ⅞in. to 3 1-16ths, another for sizes between 1¼in. to 1⅞, so as between them to answer for boring all ordnance models for the Government. For drilling the preparatory holes below ⅞in. diameter, the system above noted was used, to ensure exact centres and straightness of bore; and in forming the curved chambers of the models different cutters with tail screws were inserted in a hole tapped on the axis of a long boring bar, also used in the latter. The scheme was eminently successful.

The Cornish (Fig. 10) is a useful lathe drill. The stock is cylindrical throughout (except where squared for the hook-wrench above noted), is enlarged at one end, and has a diametrical mortice with a cutter *c*, notched out to take the flattened sides of the bar, secured with a wedge *w*. As the Cornish bit is used on the lathe it is only supported by the work at one end, and the poppet-head at the other, therefore a bearing piece *b* is fitted in a chamfer groove or underside of stock, as shewn detached, to keep it central. The three edges (cutter and bearing piece) are all turned in their places, and the cutter is levelled and rounded so as to cut at the front only, after which the parts are hardened. These bits are made for holes larger in diameter than 1¼in., and every stock may admit of an increase in size up to 2¼in., and larger sizes in proportion.

Messrs. Maudslay's boring bits with loose cutters are represented in Fig. 11, and range from 3 to 12in. in diameter, with a power of variation in size. The stocks of the smaller sizes are of wrought iron, the larger in cast-iron, the cutters rest in contact with a fillet made on the stock at right angles to the axis, and held down by screws passing through mortices in the cutters, to enable these to be set out to various diameters. The bearing piece, though generally fitted in a chamfer groove, is also made to admit of setting-out packing to make the points of bearing fall in a circle similar to that to be bored.

Mr. Stevens' lathe drill is shown in figs 12 and 13. It has two cutters, adjustable for various diameters, and is intended to be used with the loop. The cutters *c c*, lie in oblique grooves, the ends of which are at an angle of 45°, and between them is placed a wedge *w*, *w*, the shaft of which extends through the entire length of the drill shaft. When the wedge is set forward (by tail screw and nut) the cutters are thrown out as desired, so that the bit for 1in. holes may thus be enlarged for any size not over 1¼ in., and so with the larger tools. The cap plate *p*, *p*, is attached by three screws, and has a shallow recess within which two pins fixed in the cutters are loosely contained to prevent loss. The cutters have their ends rounded, and sharpened as in fig. 3, and the two edges of the shaft, marked from *a* to *b*, are made symmetrical and with rectangular edges, for the loop, from which this drill receives its axial guidance.

Mr. Kittoe's expanding half round bit, figs. 14, 15, 16, have three parts instead of two made to adjust radially and equally. The tool is used as a common half round bit, from the one point only being sharpened, and there being a bottom bearing upon

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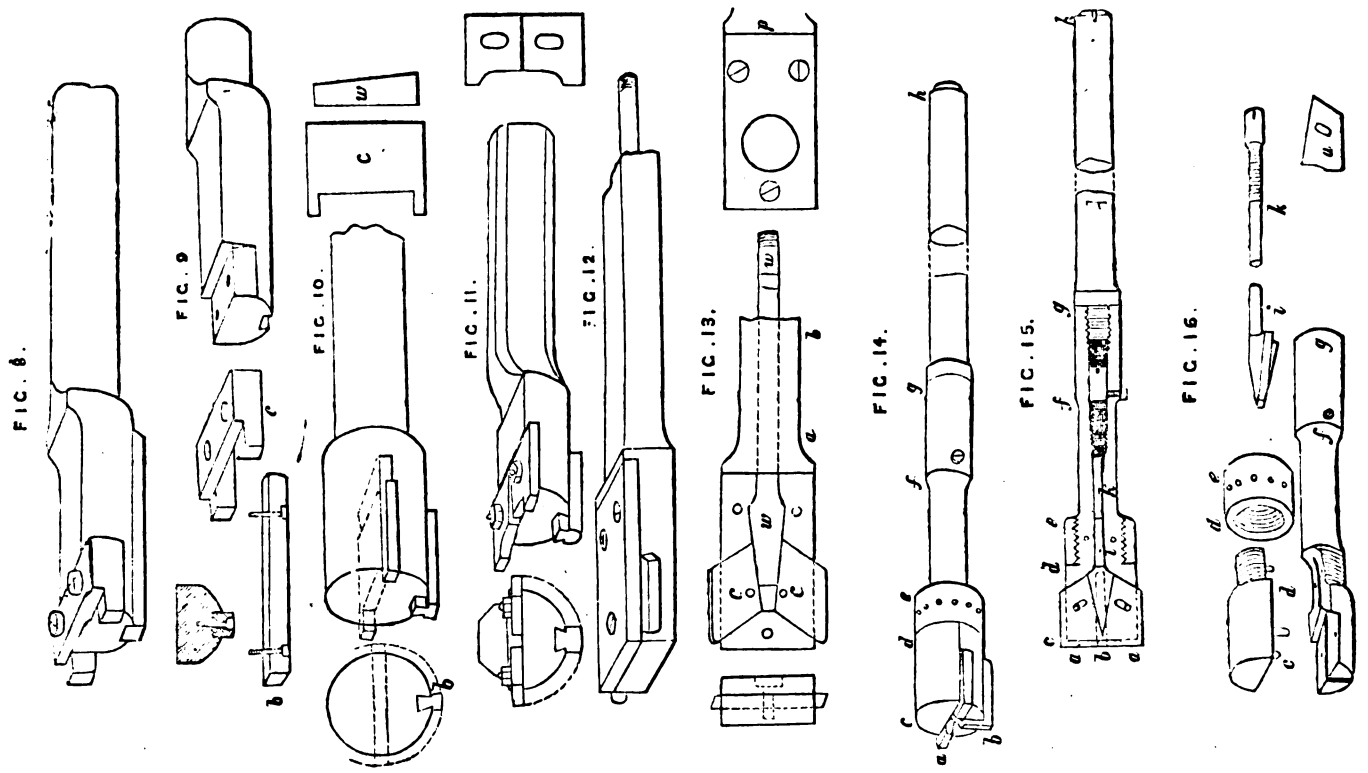
the surface of the hole that is bored. Fig. 14 shows the boring bit in condition for work. Fig. 15 is a horizontal section of the same, and *a* to *k*, fig. 16, are the parts shown separately. The part *c* to *g* is of brass, and contains all the mechanism; *g* to *h* is an iron rod screwed into the brass as a shaft, of any length required. From *c* to *e* is in two pieces, which separate nearly on their diameter, and are united jointly by steady pins, and the screwed nut *d e*, the division being made to allow of the introduction of the two bits *a a*, only one of which cuts; *b*, the bottom bit, is inserted in a similar but vertical cleft. The central wedge *i* advances the three bits equally and simultaneously; this wedge is conified, reduced to form three fins at right angles to one another, that enters the groove for the bits; this wedge is set forward by the tail screw K. There is a side screw to prevent movement by this set screw K, which is only comeatable by removing the socket *c g*, from the stem *g h*. If the wedge with its fins were advanced somewhat beyond its present position it would stand before the cutter, and keep the tool from getting to the bottom of the hole; to



avoid this the back edges of the cutters are made at the same angle as the wedges. The cutters have oblique mortices which pass over the holding pins in the semicircular piece, and prevent the cutters being lost, which they sometimes "mysteriously" do.

COOLING AND FREEZING.

(Concluded from page 74.)

To shew how the apparatus acts as a regulator: — Let us suppose partial escapes, and too little water in the cylinder, the piston *a* rising, the mercurial piston going down the valve *u*, floating on it closes the chamber *o*, and the rest of the apparatus stops. The piston continuing to rise, a vacuum taking place in the pump draws the water which penetrates through the leather, and fills the body of the pump. With a stuffing box an additional valve would have been necessary. The safety valve prevents the water entering in excess should the cooling be pushed too far. As to the compression chamber provided with a second valve u^1, its object is to prevent the passing of globules of mercury, it only comes out when the apparatus is working with air, for example, to dry the interior of the tubes and of the receivers. All the pipes and receivers should be tested to ascertain their powers of resistance, and to detect the least leak. The water before being introduced into the pump should be boiled in order to free it of air. It should also have mixed with it about 1-500 of crystallized sulphite of soda to prevent it oxidizing the iron parts of the apparatus. After closing all joints to cut off communication with the exterior, the apparatus is freed from damp. For this purpose there is fitted over the opening f_1 of the generator caoutchouc pipe carried from the bottom of a vessel filled with sulphated pounce; the apparatus is set gently to work. and the air drawn, it escapes from the opening *g* of the condenser. A glass tube, charged with a small quantity of caustic potass, shews the state of dryness of the current of air. The air has now to be expelled from the tubes and receivers by driving in the vapour of some frigorific agent, which may be ammonia, sulphurous acid, or hydrochloric ether; say we take ammonia, the vapour of which is lighter than air. Two flexible tubes are fixed upon a drying vessel full of caustic potass, and in communication at bottom with an impermeable bag charged with a weight, and continually fed with ammoniacal vapour cooled to zero. The ends of these flexible tubes are fitted on the cock θ of the suction tube I and of the conducting tube D. The vapours pass to the generator by the passage of the cock h_1, which is open, and replace the air which is expelled by the orifice f^1. Then the apparatus is allowed to work for some minutes to clear or purge the interior of the pumps and compression chambers, the expulsion is effected by the orifices S^1, S, formed in the compression chambers, and the machine is closed or stopped.

When the cock π of the conducting tube D is opened, the ammoniacal vapours pass into the condenser by the passage of the cock C; the air is expelled by two orifices formed in S^1 at the bottom of the tube D and in h^{111}, furnished with a cock in which terminates the discharge tube, plunged in the condensation receiver, and indicated in the drawings by the dotted lines a^1. The tube and receiver are then perfectly freed from air. The orifices S_1, S, are closed, and then is fitted to h^{111} the end of the tube *m* in communication with the feed cock C. The apparatus is allowed to work for some seconds, the vapours finding no other outlet, the cock being reclosed, are expelled through the feed cock and escape by the tube g_1, driving the air before them; when this last operation is finished, the end of this tube is fixed on the orifice f_1, and the machine continued to be worked. The vapour driven back successively into the condenser is compressed more and more, the pointer of the manometer advances progressively towards the division which indicates that liquefaction has commenced. The changes of state take place successively, but for this purpose it is necessary that the temperature of the condenser should not rise, notwithstanding the redisengagement of latent caloric freed by the liquefaction produced, and that is the object which this apparatus fulfils; the sensible heat freed by the liquefaction of the vapour is suppressed by the vaporization of water on the outer surface of the condensing tubes. The upper ends of the nets which dip in the vessel B formed at the upper extremity of the condenser being once primed with water, the cambric lining is uniformly damped over its whole extent by capillary attraction, the draught which traverses with rapidity the space marked by arrows, as well as the heat from the condensation of the vapours, vapourise the water, and this evaporation absorbs the excess heat. This method of cooling by draught is based on the same principle of producing cold by evaporation, and has the advantage of economising refrigerating water, and also of economising the mechanical work by lowering the temperature to the lowest natural temperature of the current of water. When the condensing receiver is full of liquid up to half the level gauge i^1, the cock is opened which closes the orifice f^1, and the congealing fluid commences to enter in proportion into the generator by the regulated play of the feed cock C. In order that the level i^1 may remain invariable, the duration of the action of the feed cock is modified as may be found necessary. The level of liquid is raised in the generator up to half the glass indicator j^1. The cock θ is first closed and afterwards the cock of the generator h^1 opened, and the apparatus is ready for use.

When the apparatus is in work the pumps being fed this time directly from the air in the generator, in proportion as the tension of this air diminishes in the dome F, the volatile fluid disengages from its mass a fresh quantity of vapour to saturate the space, at the same time a proportionate quantity of sensible heat is absorbed in a latent state, and this quantity of heat, equivalent to the caloric of elasticity due to the change of state, not being compensated by a constant source, the evaporation is maintained at the expense of the heat of the surrounding bodies, and the refrigeration of these bodies is the more intense as the vaporization is more rapid or prolonged. The result is that the fluid circulating in N is exposed to the refrigeration which furnishes all the heat, and consequently the temperature of N is lowered; N loses all its heat and becomes a source of cold, which cools in its turn the bodies exposed to its action.

In the manufacture of ice the first process is a

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ollows:—It is a mechanical operation consisting in congealing the water in a constant and continuous manner by the circulatory movement of a refrigerating medium, and in depositing the ice as it is formed. A layer of ice is thus always separated from the water to be frozen, and is therefore not opposed to the diffusion of the heat which it is necessary the water should lose. Fig. 3 shows the apparatus in vertical section, and figs. 4 and 5 in plan.

a is a chamber in which a generator *b* is placed; it is covered by a second chamber *c*, open at front and divided into two compartments *d*, *e*; in the bottom of *d* two openings are formed, one of which gives passage to the dome *f* of the generator, and the other, which is furnished with a pipe, receives the body of a screw propeller *g* resting on a pivot, so as to turn freely round its vertical axis; toothed gearing *i* transmits the motion to the shaft of the cock *j*; a metallic disc *k* covers the compartment *d*, and allows passage to the upper part of the dome and the propeller rod. The compartment *e* receives the icer *l*, it is composed of a metal cylinder supported by two pivots, *m*, *n*, the ends of the cylinder which are narrowed are supported in bearings, and terminate in pipes *o*, *p*, the pipe *p* communicates with the generating chamber and the pipe *o* with the propeller chamber; stuffing boxes *q*, q^1, allow the cylinder to turn without there being any loss of the liquid in circulation; the uncongealable liquid which circulates in the interior of the machine is a mixture of one part alcohol and two parts water, which has the advantage of not deteriorating as saline solutions the metallic parts; the bath being completely enclosed there is no loss.

A toothed wheel *r*, fixed to the end of the cylinder, gears into a wheel *s*, which receives motion from the spindle of the cock; *t* is a steel scraper of prismatic form fixed on supports, following the longitudinal direction of the cylinder, and in a direction opposed to its movement, so as to be directed tangentially against the length of the circumference of the cylinder, and on the lateral faces being free to slide as a carriage on its support, and being held by pressure screws at any desired distance. The pieces *u u*, which form a right angle with the scraper, is connected by binding screws; *v* is a trough of tinned copper, in which part of the cylinder dips; it is constantly fed with the water intended for freezing. The whole machine is enclosed in a double wood casing *x* fitted at its upper part with a cover and at front with a shutter.

The machine being arranged as before described, when rapid rotary motion is imparted to the propeller in the direction of suction, the uncongealable liquid being confined in the generation chamber answering to the attraction produced by reaction, an ascending current is formed, but as soon as the liquid is precipitated into the propeller chamber, the contents of the latter traversing the cylinder *l* by the pipes which correspond is driven into the propeller chamber and replaces the displaced liquid, and consequently during the time the propeller is worked, a correspondingly rapid circulation is kept up in the cooling apparatus.

The cylinder *l* being put in motion, let us suppose the liquid which circulates therein is cooled 4°; the cylinder which in touching the water in the trough congeals it, and becomes covered with a layer of ice; the scraper *t* removes this ice, which is deposited in powder in the ice chamber *e*. A cock *y* and overflow *z* allow of a constant level being maintained in the trough; the water which falls drop by drop by the overflow orifice, indicates that the trough is fed in proportion to the transformation of water into ice. The product being strongly packed in wooden cases, is formed into blocks of ice.

NEW MINERAL.

A new mineral of lead has been discovered in Chili, containing 10 per cent. of iodine. Iodine has lately become very valuable, on account of its extentensive use in photography, and of the discovery, by Dr. Hoffman, of a new dye, having this element among its constituents. It is said that one cargo of the new mineral will represent a fortune. As a further illustration of the progress that mining adventure is making in South America, a mine of bismuth ore has recently been opened in Bolivia, about two-thirds up the highest of all the peaks of the Andes—the Iljampu Mountain. Bismuth, also, has lately increased in value; and 15,000 feet above the level of the ocean, only slightly beneath the line of perpetual snow, men are setting to work to obtain it.

TREES, &c., which fall into the pitch lake of Trinidad soon become true coal.

THE SOHO WORKS, BOLTON-LE-MOORS.

From the *Engineer*.

Amongst the engineering works which may almost be said to have grown with the growth of engineering itself are the Soho Works, Bolton. From this establishment have been sent, during the last thirty years massive stationary engines, many of them working in parts of the globe where, before their erection, steam power was only known by heresay. It may be termed an off shoot from the Union Foundry, of the same place, which has been at work since the beginning of the century. The Soho Works were founded in 1833 by the late Mr. Benjamin Hicks, who though he died at a comparatively early age, has, it need scarcely be said, left behind him a prominent name amongst those early mechanical engineers who were the real creators of modern engineering. It was on dissolving partnership with Mr. Rothwell, the only survivor of the original partners in the Union Foundry, that the late Mr. Hicks began to lay down the present works. The site chosen consisted of six acres of land adjoining the station in Bolton of the London and North-Western Railway Company. As is almost necessarily the case with workshops whose long existence has been attended with commercial success, the requirements of different periods, and the necessity for extension, within certain gtven limits, have since led to many departures from Mr. Benjamin Hick's original arrangement of the buildings. For a certain length of time the shops could also evidently be increased according to a definite and settled plan; but in the course of years this became more and more difficult, until we see the rather irregular block of buildings into which the workshops of an old and extensive firm generally get merged. Nearly eight hundred men, who have worked overtime for years are employed at the Soho Works in manufacturing the large stationary engines and boilers, the heavy water wheels and more modern turbines, the millwright work generally, which form the present staple manufacture of the firm.

At another part of the town is an extensive forge and steel works, adjoining each other. In the first of these are a number of puddling furnaces and hammers, and it is here where the heavy forging for the Soho Works are made. In the Bolton Steel Works, adjoining the forge, are erected two 5-ton Bessemer converters. Powerful hammers and rolling mills are now being erected for working up the steel. From five to six hundred men are employed in these two establishments, in which Mr. Hick, of the Soho Works, is one of the partners; the managing partner being a son of the late Mr. John Sharpe, of the well-known Atlas Works, Manchester. Here are also rolled the Bessemer steel boiler plates, largely and successfully used at the Soho Works. Each plate has its edges cut in a large shearing machine, one of the resulting crop ends being alway bent double in order to test the equality of the material of each plate. The ductility of the material was remarkable, and it seemed to be the very stuff for boiler making. The other arrangements of the works were of the usual character adopted for puddling, forging, and rolling.

In the good old times, when there were comparatively few engineering shops in the world, before mechanical engineering had thrown off so many separate off-shoots, and before these causes, added to the present severe competition, had divided the trade into determinate special branches, the late Mr. Hick seems to have taken a pride in turning out the most varied work. Locomotives, marine engines, machine tools, and many different kinds of manufacturing machinery, used to be made here. But marine engines are now almost solely, and at any rate most profitably, made close to where the hulls they will drive are being built; while the fact that locomotive orders are generally given for a number at a time permits the adoption of special arrangements and tools, of, in fact, special factories, such as, for instance, the Gorton Works, which do not permit the competition of establishments like these, which are more suited for the manufacture of heavy stationary prime movers and their millwright gear.

Walking through the works we see—very complete arrangements for making the large details of heavy stationary steam and hydraulic prime movers. Amongst the machine tools is thus the large vertical boring machine which, when first constructed some years ago, attracted much attention. It consists of three distinct machines, for boring, drilling, and face-grinding, respectively. Four columns support an entablature carrying the upper parts of these three different machines. In the centre is the machine for boring cylinders up to 95in. in diameter and about 10ft high. They are fixed on movable supports in the usual way by clamps, and are also steadied by a circular frame able to slide up and down. The smaller boring machine used to be employed for boring out such work as cranks' centres, but it is now found more convenient to do this kind of work in a rather more accessible and independent machine. The smaller tool on the other side of the large boring machine illustrates the progress of different modes of work, and the introduction of scraping instead of grinding. It was designed for grinding up the faces of piston rings and of similar work, which was fixed on the table as if being bored, while a vertical bar drove the grinding plate; such work is first faced up in the lathe and then scraped up, a very slight grinding by hand, with emery and oil, being resorted to at the end of the process.

Of a somewhat similar character in its way is the large planing machine, designed many years ago by the late Mr. Hick, for planing large cast iron plates for glass casting. Old as it is, however, it was only a few weeks ago that an American engineer, in the course of a visit to these works, stated that he had re-invented and patented a planing machine after the very same plan—a coincidence which he only accidentally discovered after having sacrificed much time and money. The peculiarity of Mr. Hick's machine, once a wonder in its way, consists in making the tool move while the work remained stationary. It will take in a plate 30ft. by 12ft., and is also able to receive a cylinder of 400 horse power in order to plane up the valve-box flanges and the other surfaces. The framework is formed of two longitudinal side pieces, on which rest the cross slide pedestals carrying the cutter box. We understand that the cross-slide consisted at first of a round bar, able to slightly oscillate the cutter box holding two tools—cutting each way, and alternately raised at each return stroke by the oscillation of the bar on the axis. To the cross bar carrying the tool are attached levers, one on each side, to which were connected endless steel belts passing over pulleys at each end of the machine. One set were the drivers, the other set the carriers; the friction upon the first being sufficient for the heaviest cut. As the belts moved the cross bar backwards and forwards at the return of each stroke, the oscillating motion was given to it, limited by two set pins. The machine is now fitted with one of Mr. Whitworth's revolving tool boxes.

Near the heavy vertical boring machine we spoke of first, is a lathe, with a 10ft. face-plate, capable of boring up to 16ft. diameter. A convenient plan, requiring only one setting, is adopted for boring out the eyes of engine beams. The beam is simply fixed on a table sliding in V slides, similar, in fact, to a planing machine table, the boring tool being worked in an ordinary vertical boring machine. This machine is also found very convenient for other work. A tool of, to us, rather novel form is used for facing up such work as the valve chests of large cylinders. It was designed by Mr. John Hick, C.E., the present senior partner of the firm, and it may be styled a sort of composite tool between a slotting and a planing machine. The tool box is fed down vertically, being worked to and fro on a planing machine bed, while the work is set on a fixed table, the longitudinal axis of which is at right angles to that of the pair of V slides on which the tool box is worked. On the millwright's side of the establishment, where, other but engine work is done, the separate arms o the large fly-wheels are fitted together over pits, within which one half of the wheel can turn. A lathe can thus be easily extemporised and fixed up at any diameter, and against the tool of which the wheels may be turned up. In the smaller pit, in use at the time of our visit, was being put together a spur fly-wheel 26ft. in diameter. The teeth of these wheels are never, in this establishment, cast solid on the iron rim. Such wheels, with the teeth on a separate outside rim, are found to wear much better, being free from the effects of unequal contraction, produced when the teeth are cast together with the main rim. Wooden packings, into which thin iron wedges are afterwards driven, are placed between the ends of the segments. All the boilers made there are, of course, systematically tested by hydraulic pressure, for which purpose is set up a pair of force pumps which can be driven from the shop engine by means of a belt. The smaller machine tools are placed in a storey upon the ground floor on which are the heavier machines. In order to be able to clear away the columns which would otherwise have to support a floor eighteen yards wide, and to thereby afford room for the heavy cranes on the ground floor, the flooring of the first storey is suspended from a number of slender tie-rods, attached to cross beams in the masonry. These smaller lathes and machines are of the usual descriptions.

(*To be continued.*)

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BIRTH AND GROWTH OF THE IRON TRADE.*

By JAMES ROBERTSON.

(*Concluded from page* 80.)

I do not deem it necessary to explain at any length the process of the manufacture of hot-blast pig-iron, as you are already well acquainted with it, further than asserting that in some instances the heated air driven into the furnace is obtained from a series of chambers constructed round the mouth of the furnace, deriving their heat from the blast which smelts the iron, and thereby economising the fuel: but more generally the heated air is drawn from chambers heated by a separate furnace, as any desired temperature can be obtained therefrom, and that altogether independent of the flame of the iron furnace, and at a very trifling cost. There is a great preference given to cold blast iron where castings require to possess a smooth and hard surface, but where fluidity of the metal when molten is necessary to bring out the fine details of a casting the hot blast pig is decidedly preferable to the cold blast. The presence of a large proportion of carbon in these pigs is the cause of their fluidity, and the principal object of the process of refining, when malleable iron is to be made, is to eliminate the carbon, and render the iron close and fibrous. It may not be uninteresting to give you a statement of the actual weight of material necessary to produce 1 ton of pig-iron. It is as follows:—

Raw Mine.....	3 tons 10 cwt.—2 tons 4 cwt. of roasted ore.	
Coal for furnace.....	3 tons 0 cwt.—2 tons 5 cwt. of coke.	
Ditto for kiln, engines, &c.	1 ton	0 cwt.
Lime as flux	1 ton	0 cwt.
Total.....	8 tons 10 cwt.	

Thus presenting a total weight of material of 8 tons 10 cwts. for every ton of pig-iron raised; and before this ton of iron reaches the condition of manufactured there will have been expended upon it a quantity of raw material equivalent to a weight of 14 tons 10 cwts. The manufacture of iron in Scotland had been behind that of the southern part of this island, but the discovery and general adoption of the hot blast produced the most extraordinary development in her production. In 1845 the quantity produced in Scotland was 475,000 tons; that production gradually increased till, in the year just closed, it reached the enormous amount of 950,000 tons for Scotland alone; and the production of the whole of the blast furnaces in Great Britain and Wales gives a total for the last year of 5,600,000 tons. Here is a source of internal wealth; here is a production in iron equal in value to the annual imports of gold from Australia, even taking the value of the iron at a low figure, in round numbers; a source of wealth for the development of which we require no external aid, a wealth raised by the diligence, industry, and perseverance of our mining workmen, stimulated by the enterprise of capitalists; a source of wealth secure from attacks from without, so colossal as to require no protective duties, so abundant that all foreign states shrink from competition, and defend their own monopolists by prohibitory rates; and yet, although we once did the same, and were obliged to import iron for agricultural and engineering purposes, yet that period has long since passed; competition has taken the place of monopoly. Free trade has received, as regards iron in this country, a complete justification of its principles. We do not exclude the foreigner from our markets, but he excludes us from his; besides, he levies an export tax, which our Government has long since abandoned, and he will neither buy in our markets nor let us buy in his, even if we could do so at a profit. The iron produce of the whole world is only equal to about two-thirds of the produce of Great Britain alone. You may, therefore, say that we may well afford to be liberal in our commercial policy; but consider this, that the greatness of our production has arisen from the absence of an exclusive commercial policy, and the desire of our ironmasters not to exclude foreign material by protective duties, but by the superiority and facility of our production, and to these principles and our restless activity in discovery is the present greatness of the iron trade attributable.

France has hitherto produced a most inconsiderable quantity of iron in proportion to her population, it is not equal to the produce of South Staffordshire alone, being only about 800,000 tons: there are many ironworks in France, of which the most important are Cresot, Fourchambault, Hayange, and Vosges; there are several groups of iron works in the north-east, north-west, in the Indre, and La Vendée, and groups of coal fields in the south. But a narrow and prohibitory policy has hitherto restrained the ironmasters from developing the resources of the country, and not only the masters, but the workmen in the mining districts of France, look upon anything approaching to free trade in iron with foreign countries, especially England, as the death-blow to their industry. It must not be supposed that the raw material does not exist—it is found in abundance—but not in juxta-position, as in England.

Mr Perdonnet, in his report to the Societe Institution, said that "France has an inexhaustible supply of minerals, excellent in quality, and most of them equally rich with the English minerals. There is pit coal in abundance, many kinds yielding excellent coke, well suited for the blast-furnace, costing less at the mine than English coal, except at a very few places. Limestone and fire-clay are to be had at the quarry equally cheap, and the labour costs less in France than in England." But the coal, ironstone, fire-clay, and limestone being all found in different localities, and there being no canals or railways to bring the raw materials together, the expense of transit becomes so great that more than a third of the value of the iron is eaten by the expenses of the carriage. At Fourchambault, the coal of St. Etienne, which costs only 5f. (4s.) at the pit's mouth, has increased by the outlay of carriage to the ironworks to 30f. (24s.) per ton. So you see this item of carriage becomes most serious when it requires so many tons of coal to make every ton of iron, and one which must materially add to the cost of the material; that is only one instance of many similar cases. But this defect is being daily remedied; locomotion by railways and canals is daily becoming more easy. The commercial treaty with France strikes £2 per ton off the duty on bars.

The policy of France with regard to iron has been till now what ours was up till the year 1825, when the duty was abolished, though not without opposition from several of our ironmasters; and if France attains so great a development, commencing from this date, as we have done from the date of the abolition of our import duties on iron, what must be the amount of its production in a few years? Depend upon it, we shall not stand idle. The foreigner may tread upon our heels, but the touch will only be the signal for a new bound, and he will be distanced. Continental engineers now produce works of engineering skill which demand and receive our praise. The workshops of Paris, Mulhouse, Vienna, and Berlin are no contemptible establishments, and an Englishman beholds with gratified pride that the machinery and tools in use there either bear the name of one or other of our makers, or are modified from an English type.

The annual make of iron in Spain is estimated at 8000 tons, a contemptible quantity for a country rich in minerals, and having a population of some 15,000,000. Sweden and Norway have long been celebrated for their iron mines. The cause of the superiority of Swedish iron has never been accurately ascertained; it has been attributed by some to one cause, by others to another—such as the manner of working, the presence of manganese, and, with a great amount of probability, to the superiority of the mine in the first instance. Large quantities are exported annually from Sweden for conversion into steel, but the whole exports do not exceed 80,000 tons per annum, and the production of unmanufactured iron is about 150,000 tons. Belgium is a rapidly thriving iron district, but its produce is limited; however, in a few years it may do wonders, as its mines are worked with great intelligence and skill. It will be impossible in a sketch like this to detail the histories of the iron trade in Russia, Prussia, Austria, and the States, even if it were desirable to do so; but I may remark, if you will permit me to use a double Hibernianism, that Ireland is the only part of England which, as regards the trade, has advanced backwards. In 1672, 1000 tons of iron were made in Ireland; now, with one or two exceptions, the manufacture has ceased.

I find that the number of operatives engaged in the manufacture of iron, including those employed in the kindred operations of quarrying and extracting the minerals, is 250,000 men, and in giving motion to the various machinery requisite for the creation of iron there are steam-engines of an aggregate force of 250,000 horses, equal to 1,000,000 men, so that altogether we have a force in this country devoted to the production of iron equivalent to that of 1,250,000 men, entirely exclusive of the manual labour employed in engineering operations. Our exports of iron, machinery, and cutlery, in declared value at the Customs, amount to £5,100,000, whilst our imports of iron amount to only £35,000, nearly the whole of this amount being paid for Swedish iron.

It was in 1740 that the iron trade was so low and languishing; it was at its greatest depression, when suddenly it began to rise; though apparently lifeless it suddenly sprang into new existence. It was at this time that improvements in the manufacture of this metal, and the increasing wants of society, raised its drooping head; it was at this time that agriculture, one of the iron trade's best supporters and friends, came to its aid. The cumberous wooden plough, which for ages tilled the soil, began to disappear. Agricultural implements of iron began to be used, the wheelless waggon began to be disused, iron tyres were adopted for the wheels of vehicles more generally, and the production of iron for the trade caused no inconsiderable increase in the consumption of its own production; but whilst the plough was being made of iron the sword was not forgotten. The implements of war were being fast improved, the cannon of the navy, and the armies of England were being augmented to an extraordinary degree. The tonnage of the ships of war was being increased, and with the increase of tonnage came guns of greater calibre, of heavier metal. The war of the Austrian succession was at this time raging. Russia was fighting with the Turks. The American colonies were clamouring for independence, for at that time America had not thrown off the yoke of England. The political atmosphere, as the phrase now goes, was at that time very clouded: the something "looming in the future" which Mr. Disraeli's telescopic eye saw a few years ago was most distinctly visible then, so England prepared to have a shot at it, and she hastened to complete her armaments by sea and land. Besides, there was rebellion in our own land; the last efforts of the Jacobites were made about this time. The Pretender (Charles Stuart) had landed in Scotland, and it was in 1746 that the battle of Culloden was fought, which extinguished his hopes and claims to the throne. So you see that those were busy and stirring times, and it is well known to you what an impulse a popular war gives to the iron trade. The note of preparation sounds with increasing clamour, the anvil is never vacant, the hammer never idle; there are tempting contracts out, the artisan is in great request, Birmingham is extremely brisk, and at such a time Brown Bess had many suitors.

Yet, whilst war and tumult were active commerce did not slumber. The great bugbear held up by foreign nations to deter England from war has always been the paralysing of her commerce, yet it has seldom chanced that England has suffered from wars, as her commerce if restricted in one direction has generally expanded in another, and we have seen our exports and imports increase in spite of all the threats and forebodings of our enemies; and however the tide of battle may have risen or fallen upon the Continent, the ocean, the great highway of our commerce has been free and safe wherever our sails were spread upon its boundless bosom.

During the first half of the last century cotton goods formed the principal items of our exports, and next to cotton in importance or declared value came hardware and cutlery. It was about the year 1770 that cotton began to be an important native production as an export, but since that time the extension and improvement in the cotton manufactures has been so great that at this time the exports of cotton stuffs and yarns amount to nearly an entire half of the total exports of British manufactures; this is attributable to the great improvement in their manufacture by the employment of machinery, and which machinery owed its existence to the iron trade. The exports during the year 1784 amounted to a little over £15,000,000 in declared value, the British manufactures and produce being estimated at £11,550,000, the balance of the £15,000,000 total value being foreign and colonial produce. In 1785 they increased by £1,000,000, the increase being on the side of manufactures. There was a corresponding increase in exports till 1790, when the value amounted to £20,121,000, the value of British manufactures being in that year £15,000,000. The same steady increase goes on up to 1818, when the exports reached £45,180,000, the value of our exported produce and manufactures being in that year over £45,000,000. There was a great development of our commerce and manufactures going on during the whole of the French revolution and war, embraced in the period from 1770 till 1818.

The day from which the greatness of the cotton manufacture of this country dates is the 15th of July, 1769, the day on which Richard, afterwards Sir Richard, Arkwright took out his patent for improvements in the manufacture of cotton. Arkwright was born of poor parents, of whom he was the thirteenth child; he had no capital but his intelligence, perseverance, and indomitable power of will, but he was one of the most distinguished members of that band of inventors, those men of practical

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talent, by whom the manufacturing system of the British empire has been brought to its present state of excellence and superiority; he was born at Preston, in Lancashire. There were no manufactories of cotton there before his time. He was by trade a barber. So intent was he on perfecting his invention that he was often long absent from his business; his wife, one of his own humble sphere, dreaded lest the business should go to the dogs, and she and the family to the workhouse, broke his models in the hope of curing him of what appeared to her to be a delusion, and refixing his thoughts upon his powder puff and pomatum pot, but in vain; he completed his invention after a labour of nine years, and it is to him the cotton trade owes so much. The merits of his improvements are fully detailed in Mr. Baines's history of that trade. Now, it will naturally suggest itself to you what a great impulse the application of machinery must have given to the iron trade, when you consider the vastness of its productions, and the value of its exports, as shown above. Arkwright's machinery was now employed in a thousand mills; the ceaseless looms were working day and night, but the prejudice in the minds of the workmen was great against the employment of Arkwright's inventions; the handloom weaver looked upon them with dismay, and saw nothing but his ruin in their employment, so little were those great principles now so generally understood—the doctrine that the employment of machinery in the productive sciences increases the demand for the labour of the industrious classes, the great fact that the manual labour of this country is by no means adequate to our productions without mechanical aid, and that if the cost of the manufacture were reduced by such means the demand for the material produced increased in proportion to its cheapness, and made this country a successful competitor in foreign markets with the productions of foreign nations, creating an increased demand for the labour of our artizans. The artizans of that time had little faith in the natural growth and development of society; they did not see that new wants would arise, that artificial desires and necessities would be created, which manual labour could never supply, but they looked upon machinery as their natural enemy, in much the aspect as the window-breaking urchin regards the policeman. Riots took place, and the machinery was burnt or destroyed, so blind and suicidal was the animosity raised against it.

INSTITUTE CHEMICAL SOCIETY, BIRMINGHAM.

LECTURE ON STEAM BOILERS.

On Thursday last an interesting lecture on the above subject was delivered to the members by Mr. M'Evoy.

Before proceeding to the subject of steam boilers, Mr. M'Evoy gave an account of the new theory, in relation to the means by which masses of water become heated, propounded by Mr. Williams, of Liverpool. He first gave the old theory, supported by Brande, Graham, and most of the philosophers of the last half century, which was that called convection, and was explained thus:—When any source of heat is placed at the bottom of a vessel containing water, the stratum of liquid at the bottom became heated, and, consequently, specifically lighter than the upper stratum, and rose to the surface, that at the top falling, and becoming in its turn light, and so on, until the whole of the liquid has arrived at a temperature of 212°, when it is dispelled in the form of steam.

It was set forth that water was incapable of conducting heat, and that the mass of water becomes heated by convection, or a carrying of the heated particles upwards, and the cool ones down to become heated in their turn. This theory is usually illustrated by suspending small solid particles in a globular-shaped vessel, and applying heat to the bottom, when the motion of the solid bodies indicates the current of heated water. But, recently, this theory has been considerably shaken by one set forth by Mr. Williams, which supposes that as soon as heat is applied to a vessel of water, vapour is at once produced, which is gradually absorbed by the water until the heat of 212° is reached, at which point the water is saturated, and the vapour escapes as steam. In support of this theory, Mr. M'Evoy performed the following experiment. A small test tube was half filled with water, and a watch glass was placed over the mouth convex side, downwards, the concave side being partly filled with water. When the test tube was held in the hand vapour was given off, and condensed on the lower side of the watch-glass; this experiment proving that steam is generated on the application of the slightest heat. Another experiment was performed to demonstrate the same fact, and also to show that water is incapable of condensing steam; it was as follows:—A large glass beaker was about half filled with water, a small stool was placed in the centre, and upon this a watch-glass, concave side downwards; upon the application of heat supplied by a small spirit lamp to the bottom of the beaker, vapour was produced, and collected in the watch-glass until the amount was sufficient to overturn it.

Mr. M'Evoy then proceeded to describe the various forms which steam boilers have assumed. 1st. The dome shape, which was used for a short time by Watt, and soon gave way to the waggon shape, which had the disadvantage of being the worst shape that could be devised for strength, often requiring bars of iron to prevent the sides and bottom from being forced out of shape, these being the weakest parts.

The Manchester boiler was mentioned as being the best for economy of fuel and greatest strength, the dimensions for a 20-horse boiler of this kind being 20 feet long, 5 feet wide, and 6 feet deep.

The London boiler (in which the fire was placed inside, and completely surrounded with water) was considered by many as the best form, but the lecturer (who is, by the way, a gentleman possessing much practical experience) mentioned some important defects. He stated, that in this form of boiler the flame does not impinge directly upon the surface; but is carried along transversely to it, thereby dispersing much of the heat. Mr. M'Evoy mentioned some experiments made upon a locomotive pipe boiler, which proved that the first foot from the source of heat generated as much steam as the rest of the boiler, he accounted for this by the fact that the flame impinges directly upon the face plate, and heats the tubes nearest to it; but, during its passage through the rest of the tubes little heat is produced.

A cordial vote of thanks was presented to Mr. McEvoy for his very interesting lecture, which brought the meeting to a close.

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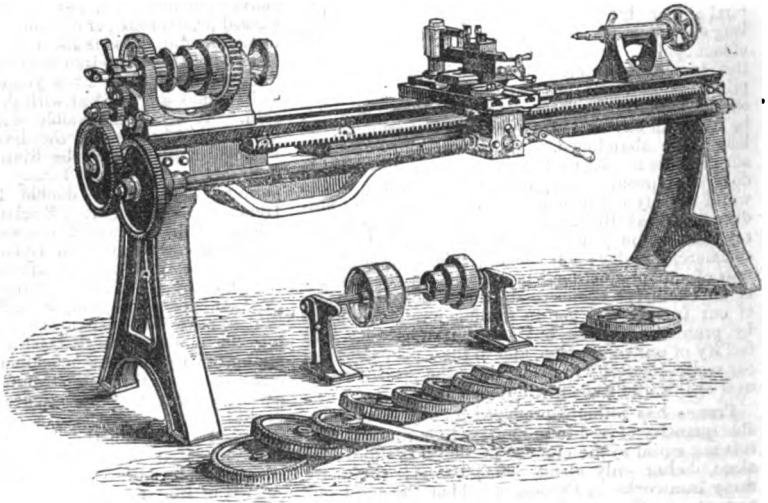

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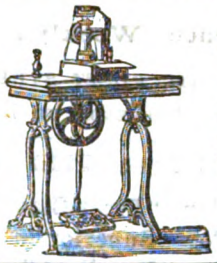

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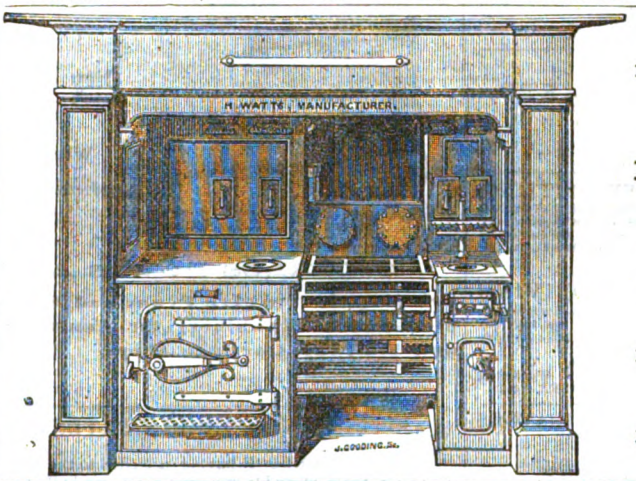

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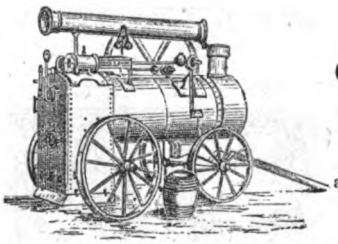

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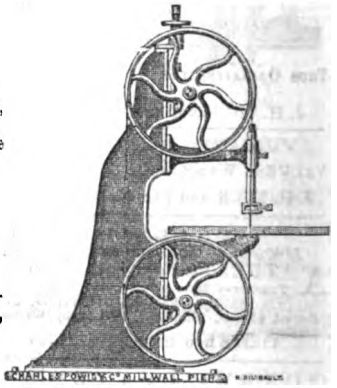

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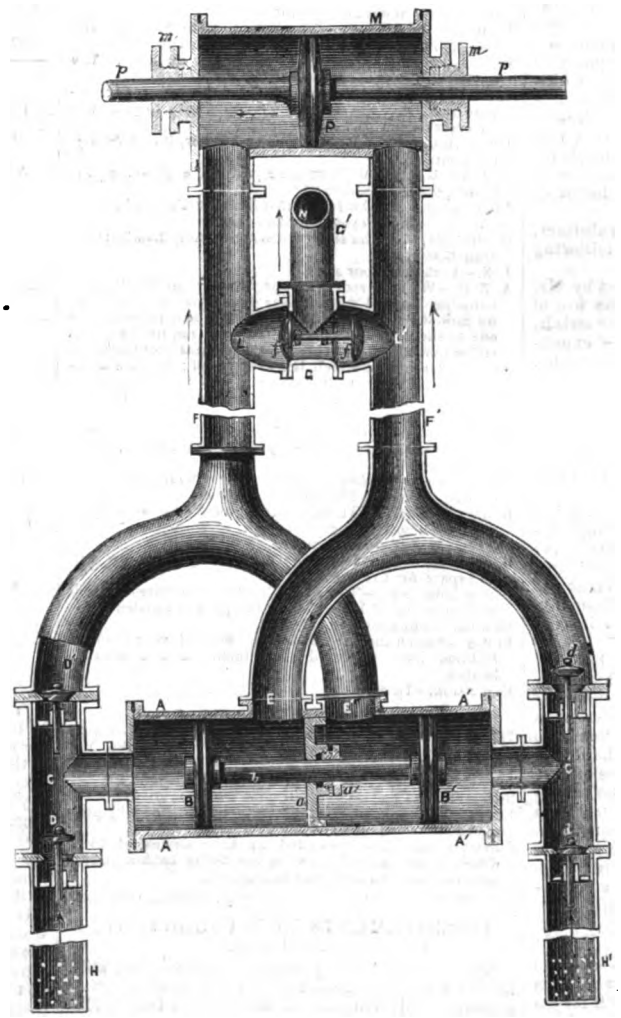
VOL. II.—No. 35.] FRIDAY, NOVEMBER 24, 1865. [PRICE ONE PENNY.

PUMP FOR RAISING WATER FROM ANY DEPTH.*

THE raising of water from great depths is a problem difficult of solution if the water is to be elevated in a single jet. In very deep mines, such as coal mines, for example, where a depth is sometimes attained of from six hundred to one thousand eight hundred feet, the usual practice is to raise the water in stages; but this entails a considerable amount of complication. Mons. F. Prud'homme, of Paris has recently invented a pumping machine which raises the water in a single jet, without the intervention of separate stations, and which admits of the motive power being applied to any distance from the shaft. This apparatus consists of two parts only; the one, which is situate near the bottom of the shaft, or about 9 or 12 feet above the water, is the actual water elevating apparatus, and the other, which is situate outside, but as near as possible to the mouth of the shaft, although there is nevertheless no limit to the distance, is a force pump, which is placed by the side of the motor. These two apparatus, namely, the actual water elevator and the force pump, are in communication with each other by means of two pipes, which serve for the elevation of water and the transmission of the power. The elevator consists of a well-bored cylinder of cast iron or copper, closed at its two extremities by metal covers. It is divided into two separate and distinct parts by a solid transverse partition or central diaphragm, against which the reaction of the water exerts itself. Within this cylinder there are two solid pistons of equal diameters, fixed upon one common rod, working through a stuffing box in the centre of the diaphragm. Suitably disposed valves admit the water from the wells into the elevator, whilst other valves enable it to be expelled therefrom—the water being alternately drawn and forced by the action of the pistons. The reciprocating movement of the pistons of the elevating cylinder is derived from the force pump, although it may be situate several hundreds of yards from the elevator. The force pump consists of a solid piston, working in a cylinder or pump body, for the purpose of forcing the water therefrom, and it may be made either single or double acting, and placed either horizontally or vertically, as preferred.

The accompanying engraving represents a vertical section of one form of M. Prud'homme's force pump and elevator. This latter is placed say 12 feet above the water level in the well. The suction pipes, H H', descend to the bottom of the well, and are perforated at their lower ends, as shown, to prevent foreign matter entering the pipes. A is a well-bored cylinder, closed at its longitudinal centre by a diaphragm, *a*, the centre of which is provided with a stuffing box, *a'*, through which works the rod, *b*, of the two pistons, B B'.

The ends of these cylinders communicate with the valve boxes, C C', which contain the suction valves, D *d*, and the outlet valves, D' *d'*. The openings, E E', permit of the inlet and outlet of water to and from the cylinders. The pistons, B B', are packed with cup leathers, or with metallic spring packing rings. The pipes, F F', which may either be of cast or wrought metal, and which should be put together with perfectly tight joints, connect the elevator with the force pump. They may rise vertically up the shaft, and may then be carried away horizontally any distance to the force pump, with which they communicate. Near to this pump the two pipes are connected together by the valve boxes, L L', containing the twin valves, *f f'*. The body of the force pump must be well bored, and closed at each end by a cover provided with a stuffing box, *m*, through which works the rod, *p*, of the piston, P, packed in any suitable manner, and receiving a reciprocating motion from any prime mover.



The general action of the apparatus is as follows:—Supposing the piston, P, to occupy the position shown in the engraving, and moving from right to left, and the whole apparatus to be filled with water from top to bottom, and the pistons, B B', and valves in their several positions indicated, the pressure of the piston, P, being exerted upon the water, will effect the closing of the valves, *f* D', and the piston, B', being forced from left to right, will carry with it the piston B; the water contained in the cylinder or chamber, A', between the end cover and the piston, B', will consequently be forced into the valve box, C', where it will open the valve, *d'*, and enter the pipe, F'. The water in the end, A, of the cylinder contained between the piston, B, and the diaphragm, *a*, will also be forced into the pipe, F', through the opening at E. The water will rise in this pipe up to the valve box, L', and as the valve, *f'*, is open, a part of the water will enter the box, G, and finally flow away by the pipe, G'. Another portion of the water enters and fills the pump body, M, as fast as the piston, P, travels from right to left. In the meantime, the water forced out by the piston, P, fills the space between the diaphragm, *a*, and the piston B', and a vacuum is formed between the piston, B, and the end of the cylinder, A, consequently the suction valve, D, rises, and the water from the well fills the valve box, C, and cylinder, A. The piston, P, having arrived at the end of its stroke from right to left, pauses for an instant, during which time the valves, D and *d'*, close again, and so soon as it returns from left to right it forces the water down the pipe, F', thereby closing the valve, *f'*, and opening the twin valve, *f*. The valves, D' and *d*, now open, and the operation is repeated through the pipe, F.

In this apparatus it will be seen that there are three equal-sized pistons, the first of which transmits to the two others the movement which it receives directly from the motive power engine, by the intervention of the column of water contained in each of the vertical pipes, whatever may be the distance between the force pump and the elevator.

* Translated for the *Practical Mechanics' Journal*, from *Le Genie Industriel*.

GALE'S PROTECTED GUNPOWDER.

Last week her Majesty and suite witnessed experiments with Gale's protected gunpowder in the Orangery at Windsor Castle. The experiments were conducted by Mr. Gale and Mr. Saunders, and throughout the proceedings her Majesty manifested the greatest interest.

A bowl of the protected gunpowder having been produced, a portion of it was separated in order to show the facility with which the gunpowder would be restored. The bowl, with the remainder of the protected powder, was then held by Mr. Gale, while a slow match was allowed to burn down into the powder. This produced no effect beyond lighting a few grains. Vesuvians were then thrown in, and finally Lord Bury's test was applied, which consists of exploding a small quantity of neat gunpowder in the midst of the protected powder. This part of the proceedings appeared to be especially interesting to her Majesty, who expressed her concern that Mr. Gale was holding the bowl too near to himself. It was, however, soon apparent that there was no danger. The Princess Beatrice and Prince Leopold, who were not present at the commencement, joined the Queen at this moment, and Her Majesty was pleased to request that the experiments might be repeated.

The Queen asked Mr. Gale if he had recently discovered the invention; to which he replied that the explosion of the siege train at Inkerman was the first occasion on which his attention was seriously directed to the subject, and since that time he had been making various experiments in order to perfect the invention.

The experiments were brought to a close by placing a bag of protected gunpowder upon a fire,

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when it was gradually consumed without any approach to an explosion.

The Queen, on leaving, said, "Mr. Gale, I thank you. I have been much pleased and interested in the experiments. It is a wonderful invention, and ought to be made very, very useful."

Instead of using an ordinary sieve in the experiments before her Majesty, a new model separator was used, by means of which a more perfect and instantaneous separation of the gunpowder is made. This machine enables the gunpowder to be separated just as fast as it may be required for use in filling shells or making fireworks, or any similar operation in which danger now arises from the accumulation of explosive powder.

COPPER AND PHOSPHORUS.

BY MR. F. A. ABEL.*

This paper was devoted to the description of a series of experiments made to ascertain if phosphorised copper would be more effectual as a material for the manufacture of cannon than the alloy now in general use. After referring to the different chemical compounds of copper and phosphorus known, Mr. Abel spoke of his experiments on phosphorised copper, with respect to its tensile strength. He found that an ingot of copper one inch in area broke under a strain of about 25,000 lbs., that of a similar ingot of gun metal required 32,000 lbs. Whilst copper combined with 5 per cent. of phosphorus required 38,389 lbs., and with 1·4 per cent. of phosphorus the strain that the ingot would bear was upwards of 47,000 lbs. Although these experiments showed the very superior tenacity of the phosphorised copper, yet there were practical difficulties which prevented the application of this compound to gunnery. In the course of the discussion which followed the reading of this paper, Mr. Abel stated that this phosphorised copper would not be at all suitable for telegraphic purposes, as the presence of phosphorus was most detrimental to the metal as a conductor of electricity.

After the paper, of which the above is an abstract, had been read, Mr. A. W. Wills made the following statement:—

So long ago as 1848 a patent was taken out by Mr. Alexander Parkes, of Birmingham, for the use of compounds of copper, zinc, nickel, and other metals, with phosphorus. The result of Mr. Parkes' experiments, more especially with respect to the copper compounds, had been so favourable as to enable him to claim for them many advantages—especially as regards the tenacity, hardness, and homogeneous character of the metal produced. This he proposed to apply to the manufacture of tubes, sheathing, cylinders for calico printers, and manifold other purposes.

Since the date above mentioned, Mr. Parkes has obtained other patents for modifications and improvements in his original process, and the manufacture of phosphorised copper, containing from ⅛ to ½ per cent. of phosphorus, is now successfully carried on at the extensive works of the Stephenson Tube Company, in Birmingham, with which the patentee is connected.

This metal is forged, drawn, and rolled both hot and cold, and its successful application to the manufacture of tubes, cylinders, sheets, and various other purposes, has established its claim to the possession of those qualities which are stated by Mr. Parkes to be its especial characteristics—viz., great hardness, homogeneousness, smoothness and evenness of texture, and tenacity. Its employment for the manufacture of large cylinders for calico printing has been especially satisfactory, by reason of these qualities.

The successful issue of the whole manufacture appears, however, to depend upon the careful selection of materials, and upon certain niceties of manipulation, which are absolutely indispensable

A PATENT CASE.

BARNETT AND ROUSSILLE V. LEUCHARS.—In the Vice-Chancellor's Court the other day, Mr. Malins (with whom was Mr. Owen) moved *ex parte* for an injunction to restrain the defendant, William Leuchars, from selling in boxes bearing the plaintiffs' labels any serpents not manufactured or sold by the plaintiffs. The plaintiffs claimed to be the inventors of the new firework called "Pharaoh's Serpent," for which they had obtained a patent in France and its colonies, and provisional registration in this country under the Patent Law Amendment Act, 1852. The Vice-Chancellor said that the motion had better stand over, in order, that the defendant might be served with notice of it, and accordingly directed it to stand over.

* Read at the meeting of the British Association.

ANSWERS TO CORRESPONDENTS

POWER.—An American invention.

STEPHENSON.—Try Spon, publisher, Bucklersbury.

ARTHUR.—Any skilled mechanic in a smith's shop will give you the information; you can obtain the drill-stock at any respectable tool shop.

PNEUMATIC.—Will find a belting made from cotton answer his purpose better than leather.

JACK ROBINSON.—It is a trade secret.

BARNSLEY.—You had better apply to a musical instrument manufacturer.

ED. PICKLES.—Received.

T G.—Received, but unable to spare space.

FERGUS O CONNOR.—Thanks for the hint.

VULPOS.—Call at 7, Bridge-court, Westminster, any evening after 8 o'clock where Mr. E. Korner, engineer, will give you every information on drilling small holes.

VENTILO.—Try 70, Guildford-street, Borough.

SHOEMAKER, BLEACHER, BUTCHER.—Answers to all the queries are to be found in any common household book.

WILLIAM COOPER.—Next week.

COUNTRY NOVICE.—Try 36, Sussex-street, Tottenham-court-road

HENRY LEE.—If you had watched the correspondence carefully, you would have noticed several letters on the subject. See letter of Vincent C. Davis in present number.

TYRO.—None of our correspondents could (even if willing) give you the necessary instructions, without the aid of numerous engravings, these we cannot undertake the expense of.

W. H. H.—See the post-office country directories.

J. RAP.—We will endeavour to obtain the information.

R F. M.—On one side only, and as brief as possible.

JAMES PRICE.—The result of your experiment is curious, but there is nothing new in it.

DIAMOND.—It is an American patent, write to Munn and Co, 37, Park-row, New York City, United States.

DRILLING GLASS, T. R. M.—Search back numbers. The question has been answered very often.

B. B W.—We do not think that it will answer our purpose to engrave the sketch. The difference in price was an error on the part of the printer.

J. C. (Glasgow).—Write to Spon, publisher, Bucklersbury, for a catalogue.

H. J. S.—Why not apply to some practical engineer in your immediate neighbourhood.

JOHN SMITH.—See the *Illustrated Builders' Journal.*.

W. W. W.—Explain yourself more clearly.

D. MCCANN.—Try the self regulating-burner, Booth-street, Manchester.

J. N.—Perhaps in our next.

A. Z. C.—We have received your illustration, which being valueless beyond suiting your immediate requirements we cannot reproduce. The method shown is the proper one to adopt, and if greater effects are required you can either increase the surface of your condenser or the number of laminæ of which it is composed; *surface* alone being the element with which you have to deal.

F. S.—Received, with many other communications on the same subject.

JOS. BERRY.—Joyce's prepared is the best, but it will always smoke until thoroughly ignited, and must be kept very dry.

NEMO.—You can obtain one to answer your purpose of George H. Smith, Market-lane, Ipswich.

REGTUS.—Churchill, 11, New Burlington-street, will supply you with a correct one.

J. SARGENT, JUN.—In our next.

B. MANDELL.—Thanks for the hint. If possible we will find space for the articles.

JAMES MORRISON.—We regret that your communication arrived too late for insertion in the present number.

HELICE.—Will appear in our next.

ELTON.—Search the back numbers. Several very good directions have appeared for glueing and cementing leather.

EXPANSION.—In our next.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

Several letters remain over till next week for answer.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

IMPROVEMENTS IN LITHOGRAPHIC MACHINES.

Though not bearing much on engineering, still, as an instance of ingenuity, the lithographic printing machine of M. Huguet, exhibited at the Dublin Exhibition by Messrs. Hughes and Kimber, of Fetter-lane, London, claims attention. It is said to be capable of producing 7,000 impressions per day, which is more than twenty-three times the work that could be got out of the old machines, and there are besides suitable arrangements for varying the speed of working when necessary. The inking apparatus is self-acting, and in doing colour work the cylinder stops at each revolution to give time for adjusting the paper, which is a matter of the first importance.

INVISIBLE violet rays turn guaiacum to green, which the red rays restore.

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The English Mechanic.

FRIDAY, NOVEMBER 24TH, 1865.

THE EXPLOSION AT NINE ELMS.

NOTWITHSTANDING the evidence given by Dr. Letheby at the inquest held on the bodies of the unfortunate men who met with their death in the recent catastrophe at Nine Elms, a large portion of the metropolitan public remain under the impression that immense districts are liable to be blown any day into smithereens by the explosion of any of the huge gasometers that "filthify" so many districts in and around London. Our excellent contemporary, the *Times*, which supplies a social, moral, and political code to so many, having been rather unfortunate in its scientific dabblings, has assisted in fostering this feeling of insecurity among the denizens of gas-workey neighbourhoods which, we are afraid, only the non-bursting of these immense reservoirs will in time allay. The *Times* asserted that one, at least, of the Nine Elms gasometers exploded—neither of them did any such thing. What, then, did explode? In the retort-house were three governors, or regulators, immersed in eight inches of water. Close adjoining were open smithy fires. So there were the gas and the means of explosion, other things in order for it. Some ignorant workmen—not those of the gas company—were employed in plastering this governor-house, and, somehow or other, one or more of them had managed to tilt one of the governors on one side, and so allowed the gas to escape into the large room. There it became mixed with atmospheric air in such quantity as to render it explosive; the dreadful compound reached a light, the explosion took place, hurling masses of the strong building in

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the direction of the gasometers, which, besides being thrown somewhat off their perpendicular by the sudden and severe concussion of air, were struck at the same moment by pieces of ruin projected by the explosion; thus holes were made in them, and hence what befel—but no explosion. One was converted into a huge gas burner, the gas within being burnt away in a huge column of fire, the gas in the other escaping through the vent into the atmosphere. It will be seen, then, that it was the *liberated* gas, mixed with atmospheric air, which exploded; and it may as easily be understood that it is next to impossible for a charged gasometer to explode. Air *may* get into a gasometer, but even then it would not explode. It would show itself at our burners, in a sputtering and a jumping, and occasionally a "going out," nothing more.

There can be no doubt, however, that gas-works in the heart of a city are in the wrong place. Emphatically, they have no business there. They are a nuisance, and, as such, should receive notice to quit. There are numerous localities away down the river where their filthy smell would annoy and injure no one, and where the expenses of the companies would be much decreased in one great item—coal carriage; for, away down the river, vessels could discharge into a jetty at the works, and save all cost of transhipment, as now, to bring the coals above bridge. The sums which each of their present immense and valuable sites would bring in would purchase enough land elsewhere for three works; and, altogether, the sooner they set about moving out of town the better for the inhabitants of the several localities, the public at large, and, doubtless, their own interests.

SORBY'S SPECTRUM MICROSCOPE.

THE superiority of the new form, as published by Mr. H. C. Sorby, consists in the employment of a compound direct vision prism over the eye-piece. The slit is fixed in the focus of the upper lens of the eye-piece, which is made achromatic, so that all parts of the spectrum may be distinctly seen at the same time. By using a binocular microscope, the inclined tube can be employed as a finder; and, on arranging so that a minute object is in the centre of the field, it will be directly in front of the slit fixed in the eye-piece of the other tube. On looking through this eye-piece, it is easy to see that the object is properly placed in front of the slit; and then, on placing the prism on the eye-piece, as if it were a Nichols's prism, the spectrum of the object can be seen to great advantage. This compound analyzing prism consists of two right angled prisms of flint glass, between which is a rectangular prism of crown glass, and at each end a crown glass prism of about 75°, all cemented together with Canada balsam. Arrangements are also made in the instrument, by means of a reflecting prism covering half the slit, so that the spectrum of a minute object placed on the stage may be compared with that of a larger object placed on a stage attached to the side of the eye-piece, and thus their difference or identity may be seen at a glance. It is thus easy to compare the spectra of minute crystals and of their solutions; to study the spectra of small coloured blow-pipe beads; and, in fact, accurately examine the nature of the light of any minute liquid or solid coloured substances. By using a parabolic reflector attached to the object glass, opaque bodies may be examined by reflected light; and, as a curious test-object, it may be mentioned that, by this means, a speck of blood on white paper, which would not weigh more than one-millionth of a grain, will show a perfectly characteristic spectrum.

RAILWAY STATION SIGNALS.

There is one question invariably asked when a night train draws up at a station—Where are we now? The painted board cannot be read in the darkness, but there is an immediate answer from the porter, but the worst of it is that answer, uttered with railway speed, or it may be in a provincial patois, is wholly unintelligible, and thus it happens nervous travellers get bewildered, and are frequently carried beyond the station where it was their intention to have alighted. On the Great Northern, the Great Western, the Brighton, the Metropolitan, and several other lines, they have, in order to remedy this evil, adopted a very simple arrangement devised by Mr. Wm. Grant, of Liverpool. It is this:—He has an iron frame to fit on to the top of the lamp, and from the sides of that frame he suspends a strip of stained glass lettered with the name of the station. The light from the lamp illuminates those letters, and renders them legible to any person.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

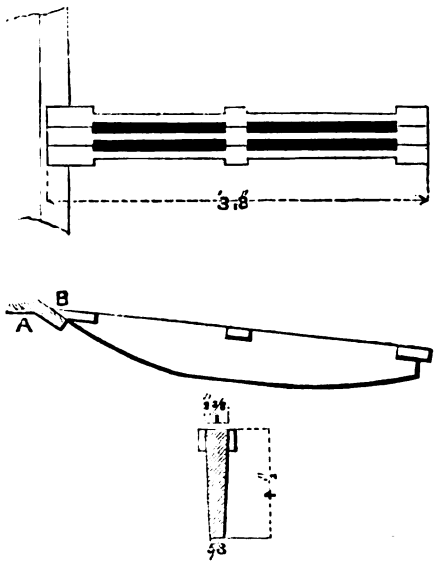
ASTRONOMICAL TELESCOPES.

Sir,—As a tyro in astronomical science, I beg to tender my thanks to Mr. R. B. Wegg, for his admirable communication on telescopes in THE MECHANIC of Nov. 10th. A word as to cost, namely, £2 10s. No doubt cheap for a good instrument, but to a working man, at the present price of provisions a serious sum. Now I have no doubt but that Mr. Wegg's ingenuity and practical knowledge would enable him to suggest how to procure a good telescope at a cheaper rate. I am aware that good lenses are indispensable to prevent refraction, &c., &c., This I believe to be the only difficulty. I have seen it stated, that lenses, for a very useful telescope, may be obtained, for about four shillings. I, for one, would feel exceedingly obliged for information how to accomplish this.

I may also observe that the thanks of the readers of THE ENGLISH MECHANIC are especially due to those gentlemen who so kindly answer queries inserted. ATHELSTANE.

FURNACE BARS.

Sir,—J. Manston not having responded to your invitation, and dissenting from T. Jackson, No. 28, Vol. 1. I forward herewith sketches of a bar designed by me upwards of 20 years since. Subjected to the action of various kinds of fuel, the results have proved highly satisfactory.



The diagrams represent top and side views, and an enlarged mid section in which A is the dead plate, the end next furnace being inclined for the bearing B of the fire bar to travel upon.

The difficulty generally experienced, arises, I think, from inattention to the laws of nature, *i.e., non provision for expansion in length.* That this plane it is worthy of consideration is evidenced by the fact of my having, during the recent erection of furnace work, again inserted a nest of town cast bars, after 2 years and five months constant service, all of them being perfect in shape and uninjured in the slightest degree, excepting where the surfaces are burred by the stoking irons in removal of slag.

F. G. MULHOLLAND.

STEAM BOILERS.

Sir,—Will you permit me to trespass on your time and space a little, the importance of the subject must be my apology. I consider it is necessary to have as clear views as possible on boiler constructions, and am willing to state my own views and experience. I am anxious also to have the views of others more experienced in this matter. In reference to A. Nelson, in your journal, Nov. 10, 1865, he says, "that I stated the hoops would only add strength to the weakest part." What I said was, the hoop would only add strength equal to its cross section at weakest part, that is, the part weakened by rivet holes.

The next fallacy your correspondent says is caused by his neglect to state the boiler designed was for an internally fired one, and in the case of flues the principle would be reversed, only the steel straps would be dispensed with.

This is the only case in which hoops may be used to advantage. Flues of greater length than ten feet are generally hooped with T or angle iron to prevent collapse.

Again, your correspondent says I will perceive that the greater the number of hoops, the stronger the boiler, in some cases. Yes, but why not add to the thickness of plates in this case, it would cost no more for work. An increase of one 1-16th of an inch in thickness would increase the strength of a 5 feet boiler in its resistance to bursting pressure 75 lbs. square inch, while the increase of weight would only be 2½ lbs. to the square foot of surface. As to defective welding, we never had a spoiled plate, and with proper care and method ordinary men may weld plates with certainty.

Plates, of course, may be rolled longer than required for boilers, and are done so at the risk of the makers, so that builders may always have good plates. As to rivetting being more safe and reliable, I beg to differ with A. Nelson. The punching of the holes near to the edge of the plate ofttimes seriously injures the plate, causing weak places in the boiler; in fact, so impressed with this are some engineers that they have their boilers drilled holes. ASPIRANT.

OUR SUBSCRIBERS' NOTES AND QUERIES.

MAGNETO-ELECTRIC MACHINE.—I shall feel obliged to E Furze if he will let me know if the springs S, S, in his sketch of a magnetic machine, (in No. 27) are in metallic communication with T, T; also, if one thick perm magnet would do instead of a compound one? Perhaps he will give me the size of it in plain figures, as I do not understand decimals?—JOHN DONNELLY.

CANADA BALSAM.—Can you, Sir, or any of your readers inform me of a means of rendering Canada balsam which has set hard limpid and fit for use? I have tried heat, but I do not find it a satisfactory means?—MICROS.

TELESCOPE.—Can E. B. Wegg inform me how to make an ordinary telescope to magnify at a distance? Price about 12s. 6d.—MAGNIFIER.

CHEMIST'S FOLDING MACHINE.—Can any of your numerous readers and contributors inform me: 1st. If any mechanist has invented or patented a machine for charging, snipping, and folding small powders, such as chemists use for medicines? 2nd. If no such machine has been the subject of experiment, can you give the name of any mechanist within whose sphere of inventive labour such a machine might come?—ARCHIMEDES.

SOLDERING.—Can you, or one of your correspondents inform me how to solder metals together in the ordinary manner of soldering; and also, how to join fine work together by means of a chemical process; and the names of the instruments and chemicals used therein?—W. H. S.

ADDRESS WANTED.—If Joseph White will send his address to THE ENGLISH MECHANIC, I shall feel obliged?—PNEUMATIC.

STEAM QUADRANT.—Can any of your readers inform me how to find the diameter of the circle of quadrants in steam engines?—INQUIRING JAMIE.

TELESCOPE.—It is stated in Dr. Dick's "Solar System," part II, p. 57, that an achromatic telescope five feet long will bear a higher power than one of the common sort a hundred feet long. Perhaps some of your readers will tell me why this great difference is, and where I can obtain pure flint and plate glass for optical purposes?—E. B. P.

FLASH PAPER.—Can any of the readers of THE ENGLISH MECHANIC inform me where I can get flash paper in Birmingham?—C. B.

STEAMING AND BENDING ASH TIMBERS.—Can any of the readers of THE ENGLISH MECHANIC inform me of the best method of bending timber? I have tried several without succeeding to my liking.—A SUBSCRIBER, Ashford.

PREPARING WOOD.—Can any one oblige me with the information, how I am to proceed in making pipes of such wood as apple tree or cherry tree fireproof, without spoiling the colour of the wood.—T. R. R. G.

SILVERING.—Can any of your readers inform me of the process of French dead silvering, such as used for dials of watches, &c.?—W. MARTIN.

MOTION.—Will any of your readers oblige me with a description of Watt's sun and planet motion?—C. W., Peterboro.

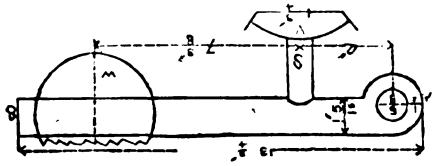
BEVIL COG WHEEL.—Will any one inform me how to make a pattern for a bevil cog-wheel and pinion; large wheel, 2ft. diameter; pinion, 8 inches; wheels to work at right angles with each other?—G. S. C.

LIGHT FOR MAGIC LANTERN.—Will any of your readers inform me how to procure a good and effective light, to show photographs in lieu of the lime light; where can a description of the "wavish light" be had?—HARRY.

RUMKORFF COIL.—Electra would greatly oblige by telling me 1st. The size and weight of tinfoil for a Rumkorff, such as he described. 2nd. If I could add a brass tube to moderate the shock? 3rd. If he knows where I can get the 42 wire, not covered? 4th. Will iron wire do for the second coil? 5th. The sort of carbon used for Bunsen's battery? 6th. If there must be the same number of inches of carbon of zinc exposed to action of the acid? By answering this you will oblige.—RUMKORFF.

PRESSURE ON STEAM VALVE.

Will any of your numerous correspondents inform me through your columns what will be the pressure per square inch of valve, when steam begins to blow off, levers loaded as above. And at what distance from centres of fulcrum must the weight W, be placed; that boiler may be loaded to 60lbs. per square inch.



A, B, is a safety valve lever, 13¾ inches over all, is uniform, and weighs 2lbs. 14½ oz.

F, is fulcrum, and is 2 inches from centre of valve spindle S.

W, is a lead weight fixed on lever, its centre is 9¾ inches from F, and weighs 33lbs.

V, is valve, and is 1¾ inches in diameter; valve and spindle weighs 1lb. 7 oz.

Lever is 1 5-16" broad (or deep), and 9 16" thick.

Centre of fulcrum is distant 13-16" from A.

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I beg to thank Mr. J. Wheately for his clear method of eccentric setting. Can he or others inform me how to set off a link in various positions (on paper), and why valve moves when gear is middled on turning engines by hand? My questions refer to link with rods attached to end.

J. M. S.

POLAR AXIS AND GRAVITY.

Sir,—In answer to your correspondent T. C., I may inform him that, according to the elaborate calculations of the Astronomer Royal, made in 1830, the polar axis of the earth measures 41,707,620 feet, and the equatorial diameter, 41,847,426 feet. Now, at the end of the year 1859, we received from General Schubert, of St. Petersburg, a redetermination, founded, however, upon relatively few data, of the figure of the earth (printed in the Memoirs of the Russian Imperial Academy of Science), in which he arrives at the curious result that our globe is not a solid of revolution, but that the figure of the equator is elliptical. He gives as the length of the polar axis 41,711,206 feet. The maximum compression $\frac{1}{292 \cdot 109}$, and the minimum compression $\frac{1}{302 \cdot 004}$. The longitude of the equatorial major axis he places at 41° 4′ E, and that of the minor axis 131° 4′ E. Upon attention being drawn to these remarkable conclusions, Captain A. R. Clarke, R.E., repeated the whole of General Schubert's calculations in a much more precise manner; using a greater number of observed latitudes, and bringing out the probable error of the elements. The results at which he arrived are these:—The ellipsoid which best represents has its major axis in longitude 13° 58′ 5″ E. The greatest and least values of the meridian compression are $\frac{1}{293 \cdot 779}$ in longitude 13° 58′ 5″ E, and $\frac{1}{309 \cdot 364}$ in longitude 103° 58′ 5″ E. The length of the polar axis he finds to be 41,707,636 feet. The difference of the equatorial axes amounts to 10,616 feet, or, roughly, two miles. It is important to observe though, that Captain Clarke "conceives that it would be scarcely correct to say that we had proved the earth not to be a solid of revolution; to do that would require data which we are not in possession of at present, and several arcs of longitude would be necessary."

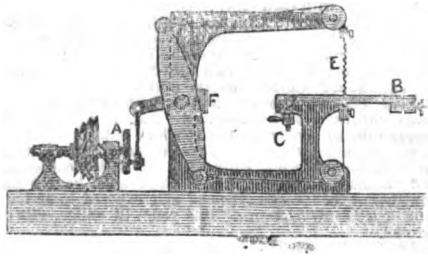
In reply to C. R., without going into any theoretical detail, he may find the centre of gravity of any body, by suspending it by means of a thread from some point of its surface; and when at rest, marking as accurately as possible, the point at which the thread would come out did it pass straight through the body. Then the centre of gravity is somewhere in this line. Let him now suspend the body from some other point, and mark the vertical continuation of the thread, as before—the centre of gravity will also be somewhere in this new line. Then, inasmuch as it is in both lines, it must of necessity be in the point where they intersect.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.
November 14, 1865.

FRET SAW.

Sir,—In answer to J. W., I send a drawing and description of a fret saw which I have made, and had in use for three years. It is my own design, and I run it at a speed of from 300 to 500 cuts per minute, and the length of stroke of the saw is regulated, as will be seen in the drawing.

When circles are required to be cut, I adjust a clamp, with centre pin, to the saw table, and set it to the required radius.



A, disc, with adjustable crank pin for regulating the throw or length of cut.
B, saw table on a pivot C, and fixed by thumbscrew D.
E, saw held in screw jaws.
F, slide carrying the elbow lever, and fixed by a set rew behind.
G, G, grooved pulleys.
H, stretching band of crinoline steel, kept in tension by the slide F.

THOS. E. MERRITT.

UTILISING COTTON WASTE.

Sir,—An enquiry was made in a former number of your valuable periodical under the above heading. At that time I had not the opportunity of sending the desired information; but I now beg to say that cotton waste may, and can be utilised by steeping a short time (say 24 hours) in a warm alkaline solution, and thoroughly washing it through, when the alkaline solution will have united with the grease contained in the waste, forming a saponaceous compound, which may be further utilised by using the solution in lieu, or with a small addition of oil for lubricating purposes, or for making anti-friction grease for colliery or other purposes.

The waste is, after washing thoroughly, dried, and used again for similar purposes as heretofore, thus effecting a saving of upwards of 55 per cent.

S. DUTTON.

MULTUM IN PARVO.

Sir,—In reply to Arrow, Whitworth's scale for angular thread of the given diameter is as follows:—

Diameter of bolt	3″	7″′	1″	5	3″	7″′	1″	Angle of Thread 55°.
	8	·16	2	·8	·4	·8		
Threads to the inch	16	·14	·12	·11	·10	·9	·8	

Hippo had better save his solutions and reduce them to their respective metals. With our present knowledge I think their application to plating purposes is out of the question. In electrical deposition we are obliged so far to be content with the argento and auro cyanides; if Hippo can cheaply convert his residues into either of these, he will achieve a success.

Chemicus should try the cement made of bees-wax, resin, and Venetian red, several times described in your columns, but what is infinitely better, is to have his spindle turned with a screw in the centre, and grip it by a nut and washer on each side. The washer may be easily and advantageously made of vulcanised India-rubber 1-16″ thick. All other cement used should be sealing-wax dissolved in naptha or methylated spirit.

Anselm Splain—Silver will not serve as a substitute for platinum in contact breakers unless he wishes to spend ten times the cost of the platinum to produce—well, say, only failure. Gold and platinum are the only metals we know of that will serve the purpose, and the latter is the cheaper of the two, hence generally used. The spring should not be plated, but a small hole drilled through, and a piece of platinum wire rivetted therein, or otherwise a piece of platinum foil twined on to the spring.

J. C. Wigg.—The permanent magnet is the steel one, and the temporary magnet the iron one in a magneto-electric machine. Steel ones are made by touch from other powerful magnets, or by insertion in a coil, through which a large volume of electricity is passed from a powerful battery, generally beyond the means of an amateur; the other is a simple core of the softest iron, that can be got wound with a large number of convolutions of very fine silk-covered wire, and only becomes magnetic by induction when passing the poles of the steel magnet.

Scientific.—Try gutta-percha. It takes plumbago as naturally as a child does the breast, and, with a little care in manipulation, gives fine sharp results.

G. S. gives only a very incorrect method of finding the pressure per square inch on a boiler under a given strain, and not the strain a boiler would bear without rupture, as tested by the safety valve, which was the question put by T. G. Maugh. Try again. G. S., and despair not.

Last, but not least, Sparrow Hawk.—Glass tube for the helix would be awkward to obtain, and is unnecessary for the job. About thirty yards of thick cotton-covered wire wound in a short helix, and attached to from six to ten Grove's or Bunsen's cells coupled for quantity, should be passed several times backwards and forwards over the intended magnet, a soft iron armature being all the time kept in contact with the poles, whatever the shape of the magnet; then break contact with the battery, and remove the armature and coil.

T. H. B.—Nitrous acid reduced by the addition of a small quantity of water renders hard surfaces of cast-iron workable.

WM. TONKES.

VOLTAIC PROPULSION.

Sir,—In answer to your correspondent John Tawse, I would remark that his proposition has little novelty in it. Some years ago Professor Jacobi succeeded in propelling a boat containing twelve men by voltaic agency. Sir Humphry Davy also employed the same sort of battery which your correspondent suggests, but for a different purpose. To prevent corrosion in copper sheathing, he attached pieces of zinc to the copper, and the zinc, by undergoing corrosion instead of the copper, left the latter clean; but, therein lay the fault, as the clean surface afforded such a good resting place, it was soon covered with marine shellfish, &c., which is much worse than corrosion. If this was to take place on your correspondent's battery, the surface exposed would be much reduced, and the battery power would suffer in consequence.

Next comes the very important question. Would it be cheaper to use zinc instead of coal? For, as the coal is oxidised at the expense of the air, so is the zinc attached by the chlorine of the sea salt, and chemical action takes place in both. Now, the equivalent of carbon is 6, and that of zinc 32. Then, 6 atoms of carbon in combining with 8 of oxygen, set free as much force as 32 of zinc in combining with 35·5 of chlorine, so that more than five times the quantity of zinc is required, and consequently a much greater outlay is required. Liebig says, that the coal used in reducing zinc from its ores would set free more effective force by burning it under a boiler than would all the zinc in galvanic or other apparatus.

I have only one more objection, and then I have done. Your correspondent suggests that the metal plates should be insulated from the ship by means of gutta-percha sheets. Now, would the gutta-percha be strong enough to hold the rivets? for it is absolutely necessary that there be no metallic connection with the ship, or the gutta-percha would be of no use.

VINCENT C. DAVIS.

STONE CUTTING.

Sir,—In reply to J. L. query—there is a small work on "Masonry and Stone Cutting" in Weale's series, at 1s. There is also a machine patented that will do square yards of rough stones out of the quarry, and bring them to a true face in one day, and polish them if required. In fact, it will do for about 4s. what it requires by hand labour to charge 15s. for. I shall be happy to give any information respecting the above.

T. JACKSON.

THE SUN EXTINGUISHING FIRE.

Sir,—In answer to the question of F. Mason, November 10th, 1865, I beg to refer him to the *Imperial Magazine*, August, 1836.

The simple reason of the sun putting out fire when shining upon it appears to be that he extracts from the burning matter that oxygen, the supply of which is so essential to combustion.

But, to the more particular reason. I surely have no need to tell any of the readers of your magazine that fire will not burn without air. And, from the supply provided for this purpose, it is the oxygen separated by the burning materials from the atmospheric air which becomes decomposed by passing through them, that alone supports and prolongs combustion. If, however, as fast as these materials should, as it were, attempt to imbibe and appropriate oxygen, a counteractive power should deprive them of it, it is evident that combustion would slacken, and ultimately cease. Now, this theory appears to me to be demonstrated in the case before us. The sun shining upon the fire is the counteractive power. The rays of the sun have a strong tendency to draw off oxygen from certain bodies containing it.

Upon this principle some metallic oxides become decomposed, and lose their colour.

If a fire that is not burning very strongly, and is not supplied well with fuel strongly combustible, that is not open to a strong current of air, be left to have the sun shining powerfully upon it, the fire would soon go out, a result I have witnessed.

The sun is not likely to extinguish a large fire, such as a furnace, which is constantly supplied with fuel, and kept up by a blast.

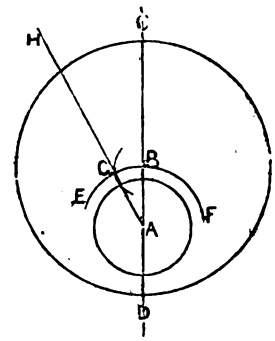
But, with a parlour fire (to which the querist, I suppose, refers) long left without attendance, with the sun shining upon it through a window, and perhaps with the window and door both shut, the fire will soon die out.

A. GROGONO.

PLACING ECCENTRICS ON SHAFTS.

Sir,—Having seen the explanation of Mr. Wheatley about placing eccentrics on the shaft in No. 33 of your valuable paper, I would feel obliged if Mr. W. would give a simpler explanation of the way he marks them off to place them on the shaft in their proper position; by so doing he will much oblige.

I also beg leave to show the way I am accustomed to put them on. It is as follows:—



Find the two centres, A, and B, through them draw the centre line D, C, with A for a centre, and A, B, for a radius: describe the arc E, F. with B for a centre, and the lap + the lead for a radius; describe an arc, cutting E, F, in G; then from the centre A, draw the line A, H, through the point G. A, H, is the line to which the eccentric is set.

The foregoing explanation is written under the supposition that your enquirers know how to set their shafts before proceeding to set their pulleys.

A COMMON ½″.

GRAVITY

Sir,—In answer to C. R., who wants to find the centre of gravity of any solid body. If he suspend a body which is bounded by two parallel planes from any two points within itself, successively marking, in each case a perpendicular line from the point of suspension, the centre of gravity will be found at the point of their intersection, which may easily be proved by suspending it in that point, when it will be found to keep any position it may be placed in. The same process would be applicable to any body, whatever its form, if we could pierce it, dimensions by straight lines.

C. N.

FURNACE BARS.

Sir,—In reply to Mr. Pritchard's wish for further particulars regarding furnace bars, I beg to say that they are 3′ 6″ long, 4½″ deep at the middle, and the cross section in centre of bar, is ¾ at the top, and tapers to ½ at the bottom. weight 24 lbs. I have them in nine boilers 24 feet long, by 7 diameter. Of course, there are two lengths of bars in fire feet box, and I can at any time lift them with the naked hand, they being almost cold with the cold air impinging against them and passing through them. The air spaces betwixt the bars are ¼. Of course, that depends upon the quality of coal used. I used slack.

THOS. JACKSON.

MAGNETISM.

Sir,—In answer to J. B., the transmission of an electric discharge through a steel bar under the influence of a magnet will produce permanent magnetism in the bar.

THOMPSON.

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MISCELLANEOUS NOTES.

Sir,—T. Stodhard would find no advantage in using a condenser composed of alternate sheets of varnished paper and tinfoil over the Leyden jar. Certainly, it is quite possible to use a condenser to answer all the purposes of the Leyden jar, provided the sheets of tinfoil are properly insulated from each other, which is no easy task to do properly. The condenser should have one end or side connected with the ground (a damp bath will do), and the other brought in close proximity, without actual contact, to the prime conductor of your machine.

J. B.—Magnetism may be produced in steel either by coiling the article with a few turns of stout wire, and joining in circuit for a short time with a quantity battery, or by rubbing the steel article a short time across the pole of a natural or artificial magnet.

W. H. H.—Platinised silver plates are obtainable at Sykes, 4, Holly-place, Rockwell, S. The price of a plate the dimensions you name would be about 5s.

I have no doubt the author of the "Handbook of Practical Telegraphy," Mr. Culley, of the E. and I. T. Co. Bristol, can supply E. McGurk, or any of your correspondents with copies of his work. The price is 7s. 6d., with perhaps a trifle extra for postage.

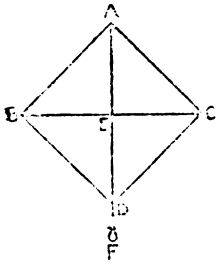
F. B. may prepare his plaster casts for the electrotyping process by soaking them, or boiling them in bees wax; next, polish the surface to be electrotyped with plumbago, or blacklead, and attach to your bath in the usual way.

EDWIN FURZE.

CENTRE OF GRAVITY.

Sir,—In reply to C. R., No. 33, respecting centre of gravity. Centre of gravity is that point (in a body) which, if supported, the body will remain at rest in any position whatever. Or, it is that point about which there are equal equilibria.

To find the centre of gravity: Suspend the body by two different points, find the lines of direction in each case, and the point where these lines intersect is called the centre of gravity. A piece of wood, for instance.



The piece of wood A, B, C, D, has been suspended at the point C, and the line of direction B, C, has been drawn, the diagram represents it as being suspended at the point A, the line of direction A, D, is shown; therefore, the point E, where the two lines of direction (B, C, and A, D,) intersect is the centre of gravity of the piece of wood A, B, C, D. The method of suspending the body is simply this: Take a piercer, and round its blade place a piece of cord or thread, to the end of which is attached a small weight (such as F in the diagram), insert the piercer's blade in one of the points of suspension, and the string will mark, or coincide with, the line of direction.

In answer to F. Mason, No. 33, respecting the power of solar rays to extinguish the heat of a fire:—

It is a well known fact that when a person's clothes are on fire, a blanket wrapped closely round the burning clothes more speedily extinguishes the fire than any other article. The same principle applies in the present case, the rays of white light being a non-conductor of heat surrounds the fire, and forms a coating or covering round the fire, which, in time, completely extinguishes it.

DAVID SLOAN THOMSON.

DANIELL'S BATTERY.

Sir,—In reply to Wm. Hoskin, respecting Daniell's battery, does he think a battery using sulphuric acid would last constant a very long time? I do not think it would last a week, and the zincs would very soon spoil, making it very expensive.

The railway telegraphs use only water, and last a long time. Some of their batteries are not attended to for six months, but I do not understand their exact construction.

Can any reader give me the exact details of the construction of a Daniell's round form battery?

ALFRED CROFTS.

VEHICLE FOR COLOUR.

Sir,—Not having seen any reply to Give and Take in No. 29, I offer the following:—

One ounce of borax, 2 ounces of shellac, 1 pint of water. Boil a few minutes, stir with a piece of wood; or 1 ounce of liquid ammonia, 2 ounces shellac, 1 pint of water. Give and Take may add more or less shellac, or use any colour he can obtain at the chemist's.

Will any one tell me what thickness wood, say oak, can be cut with the circular saw, driven by foot power?

A. LEE.

ENGINEER'S SCREWS.

Sir,—Arrow will find a very good table for tap making, from ⅜in. to 6in. in diameter—it will show how to make a full set—in the "Screw Cutter's Guide," advertised in THE ENGLISH MECHANIC.

JAMES MARTIN.

TELESCOPY.

Sir,—I have to thank your correspondents for answering my enquiry about the barometer; but, for the benefit of those of your readers who study telescopy, I may mention that, on application to Messrs. Simpkin, Marshall, and Co., for the work on that subject that Old Charlie recommends, I was informed that it is out of print, and has been so for some time.

TORRICELLI.

WINDOW MACHINERY.

Sir,—Snip can purchase a machine for his purpose much better, and cheaper than he can make one. Messrs. Bennett and Son, of St. Paul's, Birmingham, make these machines.

ALFRED NICHOLAS.

THANKS.

Sir,—Allow me to express my obligations to Mr. M'Gurk for his attention to all my queries.

As he gives his address, I will not occupy any more of your valuable space, but will communicate with him privately by post if I require any further information of him.

AMATEUR MECHANIC.

INSTITUTION OF MECHANICAL ENGINEERS.

The general meeting of the members was held on the evening of the 2nd instant, in the Lecture Theatre of the Midland Institute, Birmingham, Henry Maudsley Esq., Vice-President in the chair.

The secretary (Mr. W. P. Marshall) having read the minutes of the previous meeting, a large number of new members were elected, and the officers of the Institution were nominated by the meeting for the next annual election,

The first paper read was "On an Improved Safety Valve for Steam Engine Boilers," by Mr. William Naylor, of London, the object of which is to prevent the steam, while blowing off through the safety valve, from rising in pressure beyond the limit to which the valve is adjusted. The valve is loaded by a spring acting through a lever, one end of the lever bearing upon the valve, while the other end is bent down out of the straight line to such an extent that the point of attachment of the spring, instead of being in the same straight line with the bearing points of the valve and the centre pin, is at an angle of fifty-five degrees to that line; and, therefore, when the valve is lifted by the steam pressure the depression of the tail end of the lever causes the effective leverage at which the spring acts to be shortened simultaneously with the extension of the spring. Hence the increased pressure of the spring, consequent upon its extension by the lifting of the valve when blowing off, may be entirely counteracted by the shortening of the leverage at which its acts; and in practice the bent form of the tail end of the lever is so adjusted that, when the valve lifts by the steam blowing off, the load upon the valve is actually diminished, notwithstanding the increase of pressure of the spring. With the ordinary safety valves, on the contrary, loaded with levers and spring balances, the whole increased pressure of the spring is thrown on the valve in lifting, and the increase in the boiler pressure sometimes reaches a very serious amount. Even a dead weight upon the valve, as in stationary and marine boilers, allows of considerable increase of boiler pressure when the steam is blowing off. It has, therefore, become necessary to devise some arrangement whereby the effective pressure of the spring upon the valve may be diminished when the steam is blowing off strongly; and this is effectually accomplished in the improved valve by the bent lever upon which the spring acts. The improved valve is thereby enabled to lift to the full extent required for affording complete freedom to the steam blowing off, without under any circumstances allowing the pressure of the steam in the boiler to increase more than 5 per cent. beyond the limit at which the valve is set to blow off. At the same time the valve closes again after blowing off strongly; without allowing any sensible fall in the boiler pressure below that limit. The improved valve is in use on a number of locomotive boilers, and it is accordingly found that a single valve of only 2in. diameter gives the full area for discharge of the greatest generation of steam that is possible; while with the two large ordinary valves that are generally used of 4in. or even 5in. diameter, the pressure rises very seriously when blowing off strongly. Specimens of the valve of different makes were exhibited.

PHOTOGRAPHY.

Mr. Warren De la Rue's lunar photographs are not only interesting as pictures of our satellite, but are found to be of great importance in a scientific point of view, for an eminent astronomer has declared that, in rectifying our knowledge of the moon, more has been accomplished by these photographs in one hour than by forty years' observation of occultations. This is a promising corroboration of what has been already remarked concerning photography, that it will become of essential importance to astronomical science. For example, the moon's libration is a phenomenon of which the observation has long overtaxed the patience and ingenuity of observers; but with photography it will be at once comparatively easy and exceedingly accurate. Henceforth, a photographic department will have to form part of every good observatory.

Messrs. E. and H. T. Anthony, of New York, call our attention to a novelty in photographic paper, which, if it fulfil the promised conditions, will be a great acquisition to the art. It is stated to have a pure dead white insoluble surface. At present we have seen nothing of it; but as an interesting announcement we give the description with which Messrs. Anthony have favoured us. It is styled "Brinckenoff's Procelain Surface Photographic Paper," and the following advantages are claimed for it:—"1. The insolubility of its surface, which allows it to be passed through all the solutions necessary to the production of the photographic image without raising the fibre, which in other papers causes the sinking of the impression into the tissue, rendering it flat and indistinct, and requiring the use of some vehicle, such as gum, gelatine, or varnish, to bring it to the surface. 2. Its extreme purity of tone, whiteness of the lights, depth of the shadows, and delicacy of the half-tints, heretofore unattained on any plain paper, and its possessing all the strength of detail found in albumen paper, without the unpleasant gloss and hardness so much deprecated in all large pictures where albumen is used. 3. The surface, which is a pure dead white, resembling finely-grounded procelain, causes the image to stand out from the back-ground with a stereoscopic effect which contrasts strongly with those made on surfaces that are porous and absorb the impression into the body of the paper. 4. The facility of manipulation, requiring only the ordinary salting solution, ammonia nitrate of silver (30 grains to the oz. of water) brushed over the surface, alkaline gold toning and fresh hypo fixing, to produce the finest effect obtained by the most complicated formulas. 5. The great advantage of allowing the artiste to colour the photographs either in oil or water-colour, in less than half the time required on ordinary papers, without the use of any other preparation than that contained in the paper on which the image is made. The surface, though insoluble, is sufficiently absorbent to take in the colour without any loss in force or detail. 6. The susceptibility of a high polish under pressure if it is desired for small pictures that require colouring, such as vignette cards—usually so difficult to produce a good effect upon, owing to the non-absorbent quality of the albumen. These are some of the distinguishing characteristics of the 'Procelain Surface Paper.' Other and no less important advantages will be readily seen in the use, such as their freedom from discolouration while drying in the dark room, the premanency of the impression, the short time required in washing, for the reason that the paper, being submerged, the pores are all filled up with the material used in its preparation; hence the sulphide of silver cannot find any lodgment in the tissue of the paper, and fading is prevented, &c., &c." These are the claims, we understand, made by the inventor, and should possibly be taken with a grain of salt, an inventor being very apt to over-estimate the charms of his bantling.

MODIFICATION OF THE LENOIR GAS ENGINE.

A very valuable improvement in the Lenior gas-engine has been effected by M. Hugon, of Paris. Hitherto, the explosion of the mixture of coal-gas and air employed in these engines has been effected by means of a voltaic spark, but M. Hugon effects it be a contrivance which is at once somewhat cheaper and much more regular in its working. To the slide or other valves regulating the admission of gas and air into the cylinder he attaches little burners, supplied with gas under pressure, and he so arranges that the flame from these burners shall explode the mixture in the cylinder at the proper time. These little jets are blown out by the explosion, but are afterwards relighted by an outer jet, which is kept constantly burning. This simple improvement seems likely to considerably diminish the uncertainty and irregularity which have hitherto characterised the action of the gas-engine.

TIN wire, the thirteenth of an inch in thickness, sustains 34·7lb., a lead wire but 28lb.

THE first pendulum clock was made in 1641, for St. Paul's, Covent-garden.

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THE VELOCIPEDE.

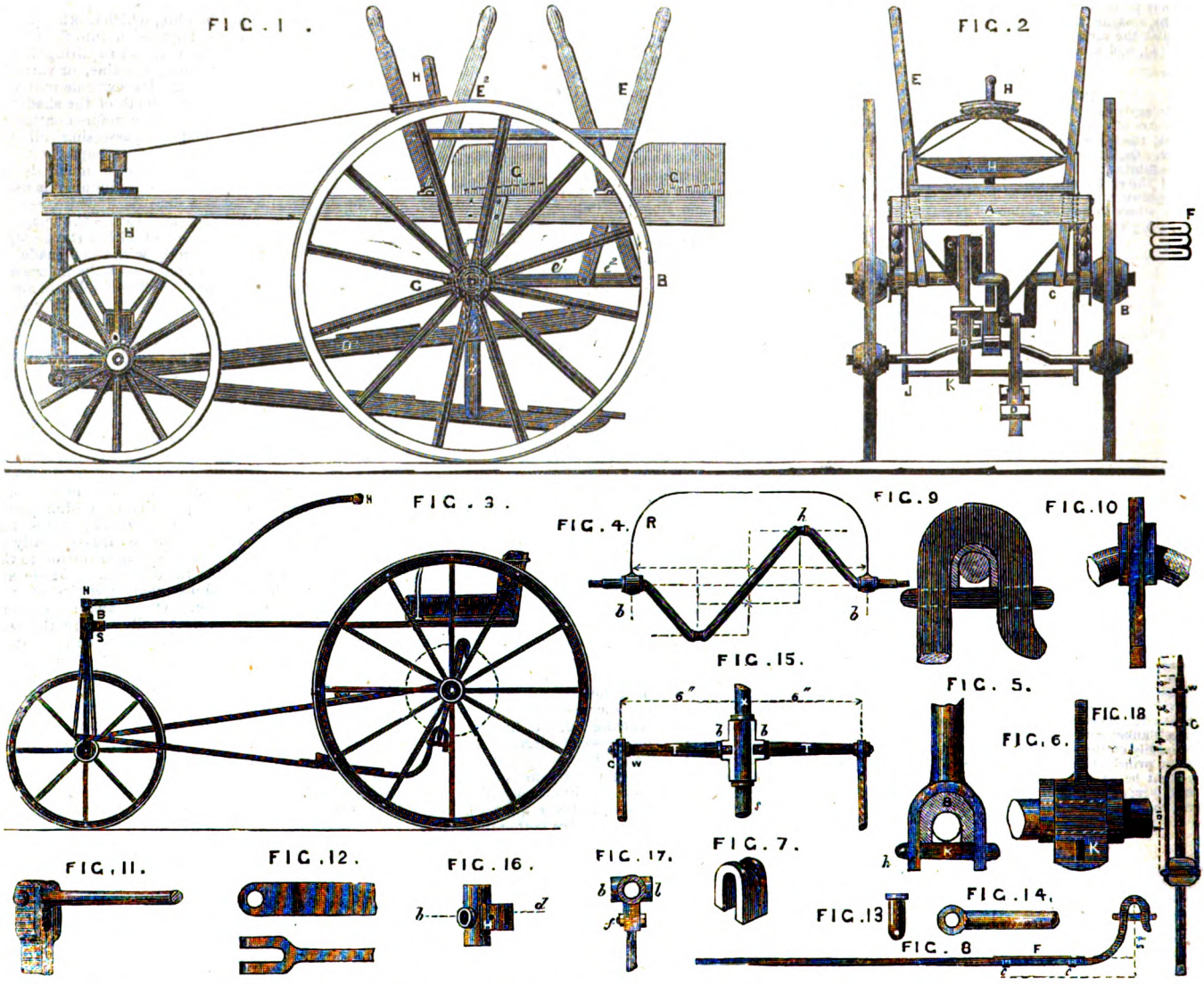
We have before us some half-dozen sets of drawings, from our amateur friends, of this useful vehicle, which seem to come more into vogue the greater the distance working men have to travel between their homes and their "jobs," carrying their tools with them in many cases. As we could not use every one's plans we have selected a few here and a few there. Of the double vehicle we give the only views come to hand. It will be evident that a high rate of velocity can be got out of one of these, constructed for the two men who are always to use it. There is a remarkable sameness in the descriptions appended to each set of drawings—in fact, in giving one we give nearly all; so no offence can be found with us on that score. The figures will be explained in the matter to follow :—

Fig. 1 is a side elevation, and Fig. 2 an end elevation of the double vehicle. A is the framing, B, B the driving wheels, worked by a cranked axle C, having cranks c^1, c^2, c_3, c_4. The cranks c_1, c_2 are worked by treadles D^1, D^2, and connecting rods d_1, d^2; and the cranks c^3, c^4 are worked by levers E_1, E^1, E_2, E_2, and connecting rods e^1, e^2. F F are india-rubber springs; G, G, are seats; H, H, steering apparatus; I, lamps; J, J, bars supporting the rod; K, on which the treadles, D^1, D^2, turn.

Fig. 3 is a side elevation of a single vehicle, constructed of steel in all except seats and wheels—which, however, may be made of iron. The framing, B, B, is 4ft 8in. long, ⅞in. deep, and ½in. thick. This, the backbone of the machine, is let into a brass socket, S, which carries the spindle of the guiding wheel.

One rib is fixed under the seat, to which it acts as a support, and this rib (shown in Fig. 4) is ⅝in. wide, 5-16ths in. thick, laid down with its wide side to the seat. The rib centre is coincident with the wheel centre, and is 9in. from back end of carriage. In making up the frame must be made red hot, and a recess formed ⅝in. wide by 5-16th in. deep to allow it to come fair to underside of seat. The distance from centre of axle to underside of seat is 9in., the wood of the seat is 1 inch thick; so, with 2in. of cushion the driver is raised a foot over the centre of the wheels, and the centre of the seat is over that of the wheels. The seat, it may be remarked, is usually made a foot in depth, and 14in. wide. A ⅜th rail is run round the seat, and fixed at the back, to give stiffness. The back of the seat should be well dovetailed to the sides, and the seat is also secured to the frame B, B by clips C, C, in U form. A hole is drilled through the clip sides and frame for rivetting. The clip ends are bent out at right angles for the screws. The rib R R is fastened to the seat by screws, two on each side the frame. The forward end of the frame is to be well fitted into the hole d, (Fig. 16). A hole, H, is drilled through the brass and iron, and a bolt inserted (shown at f, Fig. 17.)

In Fig. 4 the dimensions of the driving axle are also given. The crank throw is 6in., and the distance, as seen, from seat centre to centre of bearings as *b b* is 13¾in. The diameter of the axle is 1¼in., the bearings being turned down to ⅞in., their length being 1½in. between the collars. The bearings at *h h* are for treadle hooks, the length of wheel is 1in., and diameter ⅞in. The ends of the ribs (Figs. 5 and 6) are formed to hold the brasses in which revolve the axle bearings. The brasses are fitted into the U shaped straps, and retained in position by a flange as in Fig. 7. A steel key, K (Figs. 5 and 6), is passed through the strap ends to keep the axle from leaving the brasses, and a pin (*p*) is inserted in the key end to keep it from drawing back. The straps noted are ¼in. by 1¼in. The treadle (Fig. 8) is ⅜in. wide, and ¼in. thick; and to each side of the treadle bars a foot plate, F, is fastened by clips *c c*. One end of the treadle bar is turned up, and the other formed into a double joint, as shown. The bent-up end has a brass fitted, similar to the axle brass, though smaller; the joint at the other end is for the lower end of the suspension link. The bearing ends of the treadle bar are shown more distinctly in Figs. 9 and 10; the joint at the end of these bars is shown at Figs. 11 and 12, and the pin at Fig. 13. This pin, as shown, is kept in position by a split end. One of the before-mentioned suspension links is shown at Fig. 14. The length from centre of pinholes is 14½in. The plain part of the suspension link is 14½in. diameter, and the eyes—which should be well "trued" are ⅞in. by 7-16in. thick. The hole through the brass socket S, Fig. 3 for the spindle *s*, *s*, (Fig. 15) of the guiding wheel is ¾in. diameter. In the same figure will be seen two bosses, *b b*, one on each side the socket into which are screwed the two arms, T, T, carrying the links which swing on the ends of the arms (which are turned down to ⅜in. diameter). A collar *c* behind prevents the encroachment of the links towards the centre; a washer, *w*, on the end of the arm holds the link in position, and a pin across the point of the arm holds the washer. The diameter of the driving wheels should not be less than 3 feet. It is only necessary to fix one wheel on the axle for driving, the other revolving freely to allow of facility in turning corners. The guiding wheel and fork with its dimensions are shown in Fig. 18. This wheel is 20in. diameter, the boss is bushed with brass, and the hole is parallel. The fork is made of iron ⅞in. wide and ¼in. thick; the spindle has a diameter of ⅞in. A collar, *c*, is formed on the spindle to allow the socket S, (Fig. 3) to rest thereon, as described. A loose washer, *w*, is provided with a pin, to confine the socket in an upward direction. In conclusion we have to return our thanks to the va-



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rious correspondents who have obliged us, nothing doubting but that the correspondents who sought the information will be obliged to us for so doing.

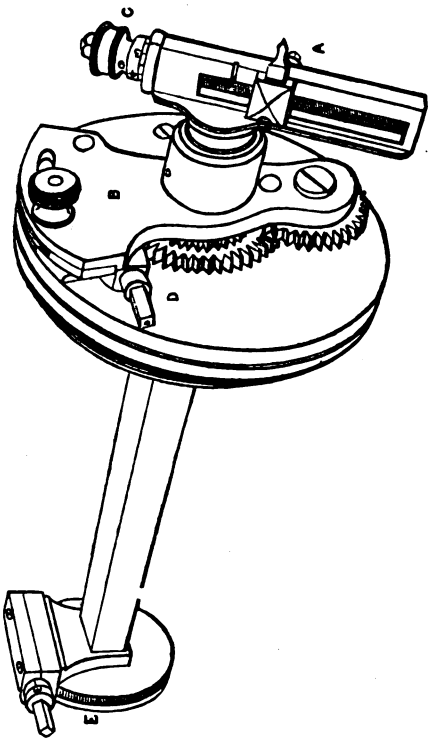
NEW BULLET MACHINE.

In the United States department of the Dublin Exhibition, Mr. Ward has on view an ingeniously contrived bullet machine. The frame consists of two hollow square sides, connected by end and feet cross pieces, between which is the gear wheel, driving pinion, fly, and compound band-wheel, and on each side piece is an arch for suspending the reels that contain the lead wire from which the bullets are made. The main shaft passes across the entire machine, with two bearings on either side piece. Between these bearings are two cams that propel the punch and die cam frame, which are guided by fixed cross pieces, and during the formation of a bullet the dies are rigidly closed. The lead wire is supplied from the reels by a self-adjusting feed, carried back by the retrograde movement of the punch bar; and by the aid of a spiral spring keeping the feed-tube lever against the set pin; the lead wire is brought in contact with an adjustable stop in the jaws of a vertical compressing forceps, which are then rigidly closed, and the horizontal cutting forceps brought into requisition, which severs the lead wire while under transverse compression. After this the vertical forceps are opened by the retrograde movement of the punch bar, when the severed piece of lead drops into a receiver in front of the dies, and is forced by the punch bar, on its forward movement, into the dies, when the bullet is formed; immediately afterwards a retrograde movement is given to the die cam frame separating the dies, leaving the newly formed bullet on the point of the punch, from which it is released by its base coming in contact with the blank receiver on the retrograde movement of the punch. There is also an arrangement for causing the lead wire from which the bullets are made to pass through packed oil-tubes immediately previous to being used. There is one remarkable difference between this invention and the machine used at Woolwich—namely, that Mr. Ward's machine, unlike the one referred to, takes up in the beginning only so much lead as is necessary to make the bullet, the Woolwich machine having to get rid of a portion of the quantity of lead first taken up.

HOLTZAPFFEL'S ELLIPTICAL CUTTING FRAME.—By Ash.

The elliptical cutting frame, invented by Captain Ash, is employed in the lathe for ornamenting turned surfaces with elliptical figures, after the same general method that the eccentric cutting frame is employed for producing circular figures on similar surfaces—viz., the object to be ornamented is fixed on the lathe mandril, and motion is given to the tool by the elliptical cutting frame, which is fitted to the receptacle of the sliding rest; or the two movements may be combined at pleasure. An almost infinite variety of patterns of a highly ornamental character will, therefore, be produced by the elliptical movement alone. In addition to which, the instrument is adapted to produce epicycloidal patterns of four loops, similar to those produced in the geometric chuck; these looped figures may likewise be made in all proportions, and be placed in any positions. From these comprehensive powers of the elliptical cutting frame, it results that any desired arrangements may be produced of circles, ellipses, right lines, or four-looped figures—the instrument is, therefore, a most desirable addition to all lathes for ornamental turning, and, if required, its powers may be still further increased by the addition of other epicycloidal patterns, or by combining its movements with those of the eccentric chuck or other apparatus for ornamental turning.

The elliptical movement of the tool is produced, as in the geometric pen and in Ibbetson's geometric chuck, by the combination of two circular movements in opposite directions, the one of which travels at double the angular velocity of the other. This is effected by the train of wheels seen in the front of the instrument, which are so arranged that the eccentric frame carrying the tool A makes two revolutions to the right, while the radial flange B makes one to the left; and the proportions of the ellipse described by the tool depend upon the relative degrees of eccentricity given to A and B. Thus, when A and B are both placed central, the tool has no eccentricity, and merely produces a dot. When eccentricity is given to A alone, the tool describes a circle, the radius of which will depend upon the movement given to the screw of the eccentric frame, under the guidance of the micrometer head C, which has ten divisions. Supposing the eccentricity to be equal to four turns of the screw, or forty divisions of the micrometer head, and that it is desired to convert the circle into a straight line, the flange B is also moved forty divisions, by means of the adjusting screw D, upon which a winch handle is temporarily fitted. Any series of ellipses between the straight line and the circle may be described by reducing the eccentricity of the radial flange B. Thus, if it be shifted five divisions between each figure, a series of seven ellipses will be produced, gradually advancing from the right line to the circle. Any other number of divisions may be adopted in the same manner—the instrument being so adjusted that equal numbers of divisions on B and C always produce the straight line. Series of concentric ellipses are produced by adjusting both A and B.



The radial action of the flange B, however, has the effect of placing the ellipses oblique to each other, instead of parallel, and this requires some compensation to be introduced. Captain Ash compensated the obliquity by shifting the division plate of the lathe a proportionate quantity. Subsequently the spindle was extended through the stem of the instrument, and a graduated disc, fixed on the end of the spindle, was employed for the compensation, but which is more conveniently and accurately effected by means of the worm wheel and tangent screw movement, suggested by H. Perigal, Esq., F.R.A.S. The tangent screw E is moved by a winch handle, and has a micrometer so arranged that the movement indicated by one division exactly compensates the obliquity produced by moving the flange B one division; and, therefore, to ensure the parallelism of the ellipses, it is only necessary to employ the same number of divisions on B and E. The tangent screw movement may also be employed to give any angular position to the ellipses that may be required. Thus, the worm wheel having 150 teeth, 37½ turns of the tangent screw will place any of the figures at right angles to their former positions. Four-looped figures are produced by changing the train of wheels. For ellipses, the train consists of a fixed wheel of forty-eight teeth, leading into one of twenty-four, to which is attached a thirty-six wheel, leading into another thirty-six wheel fixed to the axis carrying the eccentric frame A. For four-looped figures, the relative velocity of the eccentric frame is doubled by employing wheels of forty-eight and twenty-four teeth, instead of the pair of thirty-six wheels. The adjustment of four-looped figures for eccentricity and position, is effected in the same general manner as the adjustment of elliptical figures.

CORNISH STAMPING MILLS.

Mr. Hilary Bauerman's descriptive catalogue of the various models in the Museum of Practical Geology is an excellent book, and is a valuable work of reference to the traveller through that very interesting building. In the work is described, among others, the shamp-clamp at the Carn Brea Mill, and that at the Par Consols, Cornwall. The stamping mill in the machine employed for reducing minerals to a state of division sufficiently fine to allow of the classification of their component parts by the action of water. It consists essentially of a series of vertical beams, called stamps. Shod with masses of wrought and cast-iron, which are lifted by cams fixed on the circumference of a rotating barrel, and allowed to fall on the fragment of ore beneath them. The powder, or coarse sand, the product, is removed by a stream of water passing through the coffer, the discharge taking place either through a perforated metal plate, a grating of bars, or by the swell of the water over a thin-edged board or weir—the last being termed a "flasher." In the Carn Brea mine stamp, the stamp heads are 72 in number, divided into two lines of 6 each; the steam-engine is placed between them, and drives the cam barrels by a pair of short shafts, each carrying a fly-wheel, which are coupled together by the pin of the driving cranks. The stamps work in sets of three, divided from each other by upright pillars, to which are attached thick oaken planks, forming a closed box or coffer to a height of about 20 inches from the ground. The ores to be stamped are introduced, together with a stream of water, through a square hole in the hinder wall of the coffer, whilst the finely-divided material is, as noted, carried out by the stream through perforated metal plates on the front wall. The stamp bed is a mass of white cast-iron, of an irregular prismatic form, furnished with a tapered projecting tongue at its upper end, which is sunk into a corresponding socket at the lower end of a vertical timber beam, called a lifter, and is secured in place by two narrow wrought iron bands. The lifter moves vertically between two pairs of parallel guides, which are attached to transverse bars, uniting the dividing pillars of the sets together, a wooden tongue projecting at right angles from it about midway between the guides receives the action of the rotating cam shaft. Each head is lifted five times in every revolution of the engine. The cams are made of cast-iron, shaped to an involute curve, having wedge tails, by which they are keyed into their sockets on the cam barrels; the latter are hollow, cast-iron, cylinders, with flanged ends, united together by screw bolts; the journals are attached by covering plates, similar to those of the large Cornish water-wheels. A simple disengaging clutch is introduced in the middle of each line, dividing it into two parts, each of 18 heads. The ends nearest to the engine are connected with the driving shaft by ratchet couplings, an arrangement which allows the engine to be run independently of the stamps, if necessary; its chief object, however, is to prevent the possibility of the cam barrels being turned in the wrong direction, if, by mistake, the engine should be reversed by the driver at starting. The bed on which the stamp works is formed of a hard quartzose stone, stamped in a dry state to a depth of 18 inches between longitudinal walls of masonry. The ores, broken into lumps of about two cubic inches volume, are brought in wagons along a railway raised 10 feet above the ground running parallel to the whole line, and a short distance behind it, and are received in large hoppers with inclined bottoms leading into the backs of the stamp coffers. The descent of the lumps is effected partly by their own weight, partly by the general shaking set up by the falling stamps on the framing, and partly by the action of the water, which is introduced near the outlet of the hopper. In the year 1857 the Carn Brea stamp included 96 heads, divided into sets of four, each one weighing 660 pounds, and striking 44½ blows per minute, with a fall of 9 inches, the driving shaft making 8½ revolutions in the same time. The motive power is furnished by a single-acting high pressure condensing steam-engine, with an unequal-armed beam; the steam piston is 32 inches in diameter, making a stroke of 9 feet; the radius of the crank is only 4 feet. The two fly-wheels are each 20 feet in diameter. Each head will stamp about 200 tons of ore per annum, or about 13 cwts. daily (24 hours); the amount of water consumed is about two gallons per head per minute. The discharging grates are plates of copper, perforated with holes of 1-20th or 1-40th inch diameter. The weight of stamps employed in other tin mines in Cornwall varies from 3½ to 7½ cwts., the lighter ones being usually employed where water i

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the motive power. The height of the lifts is from 9 to 10½ inches.

In the stamps at Par Consols the lifters are made of rectangular balks of Norway fir, with wrought-iron tongues and guides; the latter are formed by two pairs of triangular prisms of equilateral section, one edge being turned outwards, they rub against planks of soft wood attached to the cross bars of the framing. The shorter sides of the coffer, as well as the front, are provided with discharging grates, formed of perforated iron plates; each of these rest against an iron backing, lining the aperture on the inner side of the box, and is kept in position by a wrought iron pressure frame, secured by a cross bar resting on two arms projecting from the outer side of the coffer. The front grate is of extra large size, measuring 23½ inches in length by 7 inches in height. The weight of the stamp head complete is 5¾ cwt.; the lift is 10 inches, the number of strokes per minute is 50. A double cylinder engine, on Woolf's principle, of about 50 horse-power (effective), is employed; it moves 76 heads, of which 68 are worked on tin, and the others on copper ores; 20 are "flashers," and the remainder stamps through grates. The ore stamped by each head is 265 tons per annum, or about 27 per cent. more than the yield per head at Carn Brea. The sandy mud passing out through the grates is received in a rectangular channel, called a strip; there are two of these for every set of four heads, which are in use alternately, one being cleared out while the other is filling; they are of the following dimensions:—12 feet long, 14 inches broad, 12 inches deep, with a forward slope of one in 72, or 2 inches in the length. The reputed density of the material collected is 1·3; this would give a weight of about half a ton for the contents of one strip when filled, or 14 cubic feet at 80 pounds. The filling takes place in twelve hours, during which time the four heads in the set will have worked through two tons of the ore; the sand deposited on the strip amounts, therefore, to about 17½ per cent. of the weight of the ore originally treated. The finer materials retained in suspension by the water are collected in large basins, called slime pits.

THE ENGINEER'S SLIDE RULE.*

There is, perhaps, no instrument in existence so generally used, and yet so little understood by those who use it, as the Slide Rule, the generality of mechanics viewing it simply as a "stick of inches," while the more valuable properties it possesses are utterly ignored by them.

This, to a great extent, may be accounted for by that inertia of the mind, which continually cries *qui bono?* if any attempt is made to move it from the groove in which it has habitually worked, but still more by the fact that nearly all that has yet been written upon the subject, professing to describe the instrument, is written in a style well suited to the accomplished mathematician who does not require it, but unsuited to the ordinary mechanic, being in fact a combination of technical terms without definition, and a multitude of rules without a *why* or *wherefore*, and thence it is that most who make a fair start towards mastering its difficulties soon sink into apathy, and rarely, if ever, renew the attempt.

If therefore in attempting to bring this instrument within the range of all I may occasionally appear too prolix to your higher class readers, I hope they will skip over those parts as bad readers do with hard words, remembering that there was a period even in their experience when it would have been difficult for them to explain why twice two equalled four.

The engineer's slide rule as arranged by Mr. Routledge contains on one side 24 inches, sub-divided for general use, and scales from ½" to 1"

On the other side, with which only I have now to deal, there are four "lines of numbers" marked respectively A, B, C, D, all equal in length, and the first three, A, B, C, divided exactly alike and numbered 1, 2, 3, 4, 5, 6, 7, 8, 9.—1, 2, 3, 4, 5, 6, 7, 8, 9, 10. While the line D is numbered from 1 to 10 only, each division being double the length of the corresponding one on A, B, or C.

These lines are technically termed "logarithmic," and as the term is not generally understood by mechanics, I will briefly define it. The logarithm of a number is the exponent or index of that power of a given number which is equal to the former number, thus, for instance, $100=10^2$. Here the exponent of the given number 10 is 2, signifying that 10 is to be squared, and that it will then be equal to 100; hence 2 is the logarithm of 100 when 10 is the base of the logarithmic system, and that is the one generally used for various reasons.

* Contributed by Mr. W. Tonkes.

Now if we take a series of the powers of 10, say—

1.	2.	3.	4.	5.	6.
10,	100,	1,000,	10,000,	100,000,	1,000,000 &c.

and place over each the index of its power (or its logarithm), we find that the series forms a geometrical progression—being obtained by a continual multiplication of the base 10 into itself, while the indices or logarithms form an arithmetical series of which 1 is the common difference.

On examining these two series a very remarkable property which they possess is observed, for if we add together any two of the indices and look under their sum we shall find the product of the two numbers which these indices represent.

For instance, take 2 and 3, the sum of which=5, under 5 we find 100,000, which is just equal to ^{2100} and ^{3}1,000 multiplied together, and the same result would obtain however far the series were carried, hence if we had a table of these powers of ten and all the intermediate numbers, and also the logarithms of these numbers, by simply adding any two logarithms and finding the number indicated by their sum, we should at once have the product of those numbers represented by the sum of the logarithms which we added, thus performing multiplication by addition. Again, if we subtract one logarithm from another, the remainder will be the index of a number which would result from division of the numbers indicated by the logarithms chosen; thus 6—4=2 and ^{6}1,000,000 divided by ^{4}10,000 is equal to ^{2}100, the number of which the index is 2.

Thanks to the labours of those who have gone before us levelling our track till we have comparatively "a royal road to learning," we now possess such tables as those referred to, and those "who go down into the sea in big ships," as well as those who make the "big ships" to go down in, can amply testify to their value, and such a table, limited in extent, but almost universal in its application is engraved on those four lines A, B, C, D, of the slide rule.

In order to form this table, the space from 1 to 10 is divided into 1,000 equal parts, of which 301 is set off from 1 to 2; 477 from 1 to 3; 602 from 1 to 4 &c., ·301, ·477 and ·602 being respectively the logarithm of the natural numbers 2, 3, and 4. Each division is then sub-divided proportionally into 1-10ths, representing the decimal parts between the natural numbers. Looking again at the table above given of the powers of 10 and their logarithms, it will be seen that the logarithm of 10 is 1; and therefore the logarithms of all numbers below 10 must be decimals, thus, for instance, the logarithm of 2 is ·301, and such is the nature of these logarithms that if we multiply or divide 2 by 10, or any of its powers, this decimal index (·301) is unaltered, save that an additional number is used in combination with it, such number being termed its characteristic, because it points out the precise power of 10 by which the 2 has been multiplied or divided.

Thus:—

Log. 2=0·301.	Log. $\bar{1}$·301.
„ 20=1·301.	„ $\bar{2}$·301.
„ 200=2·301.	„ $\bar{3}$·301.
„ 2,000=3·301.	„ $\bar{4}$·301. &c.

it being observed that when division takes place, the index has a dash placed over it, signifying that it is negative.

Applying these observations to the logarithmic lines on our rule we see the reason why the numbers there marked are considered as arbitrary or that any value may be placed upon them, provided that it be a multiple of such number by 10; thus the first 1 may be called 1·10, 100, or ^{1}10· ^{1}100, ^{1}1,000, &c., but in all cases the other numbers must take their value from that assigned in any particular operation to this first number.

In reading off or assigning the value of the results obtained by any manipulation, the index or power of 10 resulting from such operation must be borne in mind, since that will determine whether the number formed consists of integers, decimals, or both combined.

It is in this, which may be termed the "numeration" of instrumental arithmetic that the great difficulty of the learner lies, but I shall endeavour to simplify it as much as possible a little further on.

I have already shown that if we add together the logarithms of two numbers the sum gives the logarithm of the product of these numbers, and on this is founded the method of multiplication by the slide rule. When the logarithmic line was first placed on scales by Mr. Gunter it consisted of a single line, such as A on the present rule, and the operations were performed by taking the distances with compasses and adding or subtracting accordingly, as multiplication or division had to be performed; thus, to multiply 8 by 4, we should extend the compasses from 1 to 4, and then placing one leg upon 8, the other would extend to 32. In like manner, if 96 had to be divided by 12, we take in the space from 1 to 12, and measuring back (subtracting) the number indicated would be 8.

This however was inconvenient, necessitating the use of two instruments, and was superseded by the genius of a Mr. Everard, who gave us the slide and groove as we new have it.

This, however, required a slight modification in the mode of working which is expressed in the general rule, viz.:—

"Set the 1 on B to the multiplier on A, and against the multiplicand on B is the product on A."

Taking the example above given, we place 4 on A against 1 on B, and opposite 8 on B we find 32 on A.

So again in division, if 96 be divided by 12: we set 12 on A to 1 on B, and against 96 on A, we find 8 on B, being simply the reverse operation to that of multiplication, we subtract the logarithmic distance instead of adding it, and since these two rules form the basis of all calculations, however complicated they may appear, if they are once thoroughly mastered very little difficulty will ever oppose the career of the instrumental arithmetician.

(*To be continued.*)

THE SOHO WORKS, BOLTON-LE-MOORS.

From the *Engineer*.

(*Continued from page* 92.)

To an unprofessional visitor everything is new and astonishing in a large mechanical workshop; but an engineer rather directs his gaze to more or less exceptional things. We must thus confess that we were previously unaware that such large pistons as 3ft. in diameter, and even more, could be made with the narrow piston rings first introduced into this country by Mr. Ramsbottom, of Crewe. The large horizontal blowing cylinders for Mr. Bessemer's converters are made with such pistons. We notice that the cast-iron rings of the ordinary V-piston have additional elasticity given them by hollowing out the inside with a V-groove, and by then drilling a series of holes round the circumference, which are afterwards opened with as many radial saw cuts. Messrs. Hick and Son, with Messrs. Galloway, of Manchester, are, we believe, the sole English engine makers licensed by Mr. Bessemer to manufacture his blowing engines, converters, hydraulic cranes, and the general apparatus used in his process. A number of Bessemer converters and other work of the kind were thus being made here, amongst which we noticed a small one, 4ft. 4in. in diameter, ordered by Mr. Ramsbottom, of Crewe, for carrying out experiments in the conversion of Bessemer steel. A good deal of work is here turned out for the Royal Arsenals, amongst which we observed some small surface condensers, on Spencer's principle, intended for stationary engines. Close by was being fitted up an engine upon Corliss' patent. With a somewhat complicated appearance, and an arrangement of gearing which could not be made clear without diagrams, we feel, as the result of our examination, no doubt that the success of these engines in America and some parts of Germany, where fuel is much dearer than with ourselves, has been well deserved. At these works was, we believe, first introduced some years ago, a very simple and efficient mode of strengthening the internal flues of boilers. T-iron rings are used, on which the plates are rivetted thus ⊤⊥ a space being left between them for access in caulking, while the T-iron ring itself can be caulked in the usual way. We noticed a great number of flues made upon this principle; and the rings of plate were in addition welded together at the longitudinal joint, thus forming almost as strong a flue against collapse as could possibly be made. These works are noted for the use of a particular mixture of very hard brass. As an instance of what can be done in this way, we may state that, while in Preston a short time ago, we paid a visit to Messrs. Horrocks' large mill, which has been at work for nearly seventy years. Exactly twenty-five years ago, the late Mr. Benjamin Hick erected there a pair of very handsomely-designed beam engines, each of 100-horse power nominal, but together now working up to some 670 indicated horse-power. The cylinders are 45in. in diameter, with an eight-foot stroke, and were probably designed to work at about ten revolutions per minute, though now driven at double the speed. We were informed by the managers of the mill that these engines had been working without the least repairs for the last quarter of a century, and that the crank brasses had during that long period only worn down one-sixteenth of an inch.

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Amongst other comparative novelties in engine-work to be seen here is an engine upon Mr. E. E. Allen's principle—a plan now very generally known to the engineering public, more especially in the shape of a portable engine. It has been indicated up to 60 horse-power, and is now driving two fans, sand mixing machines, and other work for the large foundry of the establishment.

An interesting peculiarity of the Soho Works is the number of novel schemes for various purposes in stationary work, which are being tried or are being actually manufactured to meet a demand. Experiments of this kind may very often be directly unremunerative, but they are attended with indirect advantages of various kinds, amongst which may be reckoned the acquirement of a reputation for keeping abreast with the times, as well as a resulting general stimulus to the powers of invention of the draughtsmen and foremen in the works. Amongst the novel apparatuses of this category is a very ingenious hydraulic press for packing cotton, the invention of Mr. Luthy, a gentleman in the employ of the firm.

To those who have studied the history of the hydraulic press it is well known that the late Mr. Hick gave it the finishing touch after its leaving Bramah's hands, having, as can be proved by irrefragable evidence, first invented and adopted the self-expanding collar as at present used. Large numbers of hydraulic presses, and at one time, the largest presses made in the trade, have been turned out at these works. As Mr. Luthy's very ingenious press is the one recommended by the firm for packing cotton—for machines of which kind there is now a large demand in that now reviving trade—we may briefly describe it again, as it is mainly designed to economise time and labour in pressing cotton, as also to render the press itself more portable. At the same time, it must be remarked, that only a set of diagrams would do justice to its arrangements. The first portion of the stroke in packing the cotton bale—during which, as in packing hay, there is necessarily but little pressure required—is rapidly performed by means of a ram of small diameter, into the cylinder of which the water is, of course, quickly pumped. This small ram is either placed inside or outside the large cylinder. When its work is done, and more pressure and less speed is required, the force pump is made to act on the large ram, which completes the stroke. An ingenious self-acting apparatus is used for alternately admitting the supply to the rams. It consists of a suction valve, for the supply of the large cylinder during the first part of the stroke, and of a valve weighted according to the pressure of the pumps or accumulator, besides the ordinary arrangements for letting off the water. It opens and gives the pressure to the large cylinder, when the small ram meets with a resistance equal to the pressure on its useful area. There are several other noteworthy points about Mr. Luthy's press.

Mr. Hick has also tried that curious scheme for raising steam—Grimaldi's rotary boiler. The inventor is an Italian, Dr. Grimaldi, and a specimen of his boiler was to be seen in the Italian Department of the 1862 Exhibition. Such is the progress of science and the changes of time. In the last century Italy sent us Grimaldi the clown famous for his summersaults; in this century she exports a Grimaldi rotating boiler. We understand that the apparatus which is now showing worked very fairly, but that neither an increased evaporation nor a diminished deposit showed itself as a set-off for the necessarily additional complication and expense. We also doubt whether the plan is even valid as a patent, for a similar scheme is to be found described in a very old back volume of our contemporary the *Scientific American*. A very different mechanical invention is the arrangement, the invention of Mr. R. Harwood, a gentleman in the employ of Messrs. Hick and Son, adopted by the firm for easily regulating the speed of turbines and water-wheels. Applied to a turbine the clow for regulating the inlet of the water is connected to a piston. This piston is worked by means of water, let in on either side by a valve, which valve is opened or shut by a ball governor, driven by the prime mover. The motion of the clow is thus directly regulated by means of the governor, which has only to overcome the resistance of the valve itself. In the sectional elevation *a* is the throttle valve of the turbine, connected by means of the lever *b* and link *c* to the piston rod *d*, on which is the piston *e*. This piston moves inside the cylinder *f*, being actuated by the pressure of water admitted through an ordinary slide valve, which valve is itself connected, through the valve rod *g* and lever *h*, with the governor *j*. When, therefore, the turbine is running at the proper speed the valve occupies a central position, covering the ports, thereby preventing ingress or egress of water to the cylinder, and the throttle valve *a* is thus kept stationary. But should the speed be increased the governor balls fly out, and lowering the valve at end of the rod *g*, allow the pressure of water to come on the top side of piston, which moves downwards and closes the throttle valve until the right speed is attained, when the valve again occupies a central position, and locks the throttle valve as before. If, on the other hand, the speed becomes reduced, the valve at the end of the rod *g* is raised, the water pressure is brought to bear on the underside of the piston, and the throttle valve is proportionately closed until the right speed be again attained. This simple plan has been successfully in use for some time.

Amongst the inventions of Mr. Bell, the principal millwright of these works, is a simple lubricating apparatus largely made here. In the course of our visit we saw many hundreds of the above very ingenious form of self-lubricating bearing for mill shafting, and as many thousands are in use in Lancashire mills. A goodly number of different self-lubricating apparatus for shafting have been tried at various periods, but lubrication by hand is still in very general use. We remember a noted case where, in some large works in Manchester, each bearing was provided with an apparatus, worked by gearing and causing the oil to flow drop by drop from a glass cup.

(*To be continued.*)

BRONZING.

Sir,—In answer to H. T. B., I send the following recipe:—

Dissolve copper filings in aquafortis; when the copper has impregnated the acid pour off the solution, and put into it some pieces of iron, or iron filings; the effect of this will be to sink the powder to the bottom of the acid; pour off the liquor, and wash the powder in successive quantities of fresh water. When the powder is dry, it is to be rubbed on the figure with a soft cloth, or piece of leather; but observe that previously to the application of the bronze powder, a dark blackish sort of green is first to be laid on the figure; and if you wish the powder to adhere stronger, mix it with gum water. Lay it like paint, with a camel's hair brush, or previously trace the parts to be bronz d with gold size, and when nearly dry rub the powder over it.

Gold size is prepared from a pound of linseed oil with four ounces of gum animi; the latter is reduced to powder and gradually added to the oil while being heated in a flask, stirring it after every addition until the whole is dissolved; the mixture is boiled until a small quantity, when taken out, is somewhat thicker than tar, and the whole is strained through a coarse cloth. When used, it must be ground with as much vermillion as will render it opaque, and at the same time be diluted with oil of turpentine, so as to make it work freely with the pencil. An important ingredient in bronzing is gold powder, which is prepared in the following manner:—Leaf gold is ground with virgin honey on a stone, until the leaves are broken up and minutely divided. The mixture is then removed from the stone by a spatula, and stirred up in a basin of water, where by the honey is melted and the gold set free; the basin is then left undisturbed until the gold subsides; the water is then poured off, and fresh quantities added until the honey is entirely washed away; after which the gold is collected on filtering paper, and dried for use.

If H. T. B. intend bronzing plaster figures, the following instructions may be of use to him:—Lay the figure over with isinglass size, until it holds out, or without any part of its surface becoming dry; then, with a brush, such as is termed by painters a sash-tool go over the whole, taking case to remove, while it is yet soft, any or the size that may lodge on the delicate parts of the figure. When it is dry take a little very thin oil gold size, and with as much as just damps the brush, go over the figure with it, allowing no more to remain than causes it to shine. Set it aside in a dry place free from smoke, and in eight-and-forty hours the figure is prepared to receive the bronze

After having touched over the whole figure with the bronze powder, let it stand another day, and then with a soft dry brush rub off all the loose powder, particularly from the points, or more prominent parts of the figure. It will then resemble the metal intended, and possess the quality of resisting the weather. R. F. W.

The tower at Rouen, in which the unfortunate Joan of Arc was imprisoned, is about to be restored according to plans by Professor Morin.

PROPELLING BOATS.

By means of an invention which has been patented by Mr. John Macintosh, of North Bank, Regent's-park, and Mr. A. H. Thurgar, of Surrey-place, Norwich, the necessity of looking back to observe the direction of a boat is obviated. This invention consists, firstly, in using two rowlocks or fulcrums on each side of the boat; secondly, in using jointed oars, the joints of which work between the said rowlocks or fulcrums, so that in pulling the handles of the oars towards the stern of the boat the blades of the oars will be forced through the water in the same direction as the handles, thereby obviating the necessity of the rower or rowers turning round; thirdly, the oars are each made in two parts, and in connecting them together each flange of the joints or hinges is fastened securely to each part of the oar, and united together by a centre pin, thereby forming a hinge. The rowlocks are attached to the gunwale of the boat, the outer one projecting (about six inches) from the inner one, and the joint of the oar or scull working at about the centre between the two rowlocks. The novelty of the invention thus lies in the use of two rowlocks to the oar instead of one, as in the old system. The oar being jointed, the inner rowlock serves as the fulcrum to the handle of the oar, the joint of the oar between the rowlocks as the point of opposition, and the outer rowlock as the fulcrum to the blade of the oar. It follows, therefore, that, as the rower pushes the handle of the oar forwards, the joint between the two rowlocks is thrown back, causing the blade of the oar to move forwards in the same direction with the handle, and consequently as the rower pulls the handle back, the blade striking the water returns in the same direction, propelling the boat forwards.

GENERAL NOTES.

TO CLEAN TARNISHED PLATE.—Silver or plate objects may be very conveniently cleaned, if tarnished, by dipping them, when they are small, into a moderately concentrated solution of cyanide of potassium, and when they are large, by brushing the solution over the tarnished portions, then washing well with distilled water, and afterwards drying with a linen cloth.

USEFUL TO PAINTERS.—The effect of light on the aniline colours, and their decomposition which takes place with ordinary varnishes, may be avoided by first dissolving them in alcohol, saturating the solution with gum dammar, filtering, pouring the filtrate into a solution of common salt, and drying: then incorporating with an oil varnish that is free from lead.

MAGNESIUM.—Recent experiments have shown that magnesium is an excellent conductor of electricity. This, with the little tendency it has to oxidise in the atmosphere, recommends it strongly as a substitute for the wire used at present in telegraphic lines: and its general adoption depends, no doubt, on its economic production, in which direction advances are made every day.

SOLUBLE GLASS IN BUTTER.—It is too true that butter is sometimes adulterated with soluble glass—a compound of silex and potash. But the adulteration may be discovered by agitating a portion of the butter with ether, which dissolves the fatty matters, leaving the rest behind. It may be proved that this residue is soluble glass by pouring hydrochloric acid over it, heating, calcining the residue, and when it has cooled, acting upon it again with hydrochloric acid, which dissolves the alkali and leaves the silex, the chief constituent of the soluble glass, behind.

TO FIREPROOF TEXTILE FABRICS.—A very excellent method of rendering textile fabrics fireproof without injuring their colour, whatever it may be, consists in dipping them in a solution containing thirty-five per cent. gum, thirty-five per cent. starch, and thirty per cent. of the compound which is obtained by dissolving superphosphate of lime, decomposing the salt by excess of ammonia, filtering, purifying with animal charcoal, concentrating by evaporation, decomposing with five per cent silex, evaporating to a crystalline mass, and then drying add pulverising.

YANKEE NOTIONS.—Our American friends are not behind in saving themselves trouble where they can. A few weeks since we described a pea-shelling machine; we now learn that they think it too tedious to chop up cold meat for hashing, and therefore a machine has been provided to do it by power. All that is necessary is to put the meat in a case containing a number of revolving knives; then turn a handle and the hash is made. All the meat is minced before it issues from the further end, where there is a spout to allow it to discharge. This, however, appears to be nothing more than a coarse kind of hand sausage machine long used in England.

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LEAD WORKS IN AMERICA.—At the last census there were in the United States 28 lead-smelting establishments, employing 203 hands. The capital invested is 286,922 dols; cost of raw material, 938,561 dols.; cost of labour, 58,260 dols.; annual value of products (ending June 1), 1,094,122; tons of pig-lead 10,395.

OBTAINING MOTIVE POWER.—An invention, the special object of which is to enable the heat produced by combustion to be utilised in the production of motive power through a greater range of temperature than is now done, in order that a larger proportion of the heat may be converted into mechanical effect, has been provisionally specified by Mr. M. P. Boulton, of Tew Park, Oxon. He states that heat may be imparted to the fluid by injecting into the vessel some substance in a state of fusion—metals, or salts of metals—the steam being used in various ways as that produced in the usual method is employed.

A NEW ALLOY.—Gilding is much practised in the ornamentation of buildings in modern times, but silver is little used for a similar purpose, because of its liability to tarnish when attacked by sulphide of hydrogen, thus limiting the decorator to the use of gold. M. Ch. Lange, of Paris, has invented a new alloy, equalling silver in brilliancy when used in the decoration of buildings, and said to have a base unalterable by atmospheric influences. He calls this alloy metalline, and it may be used for any imaginable purpose, such as coating statues in terra cotta, porcelain, biscuit ware, or any article which it is desired to silver.

PREVENTING ACCIDENTS IN MINE SHAFTS.—Mr. C. H. Taylor, of Birmingham, proposes to provide a toothed rack along the entire length of the guide-rods, toothed wheels being placed upon the cage to take into them; a block with corresponding teeth is suspended to the chain or rope in such a manner that while the rope is tight the wheels run freely, but in the event of breakage the block falls, and locking the wheels prevents the further descent of the cage.

TIMBER OF AUSTRALIA.—The *Inquirer* (Western Australia) says:—"An engagement has been entered into to deliver on board ship at Freemantle 600 loads of mahogany sleepers for an Indian railway at £3. 13s. 6d. per load Millions of acres in the colony produce a timber which no other part of the world produces, and it is virtually indestructible by white ant and sea worm. Our colony is the only part of the world where this commodity exists, and where the supply is virtually inexhaustible."

THE Dublin Exhibition closed last week with considerable ceremony and in the presence of a brilliant assemblage. The Duke of Leinster occupied the chair, and speeches were made by the Lord Mayor, the Archbishop of Dublin, Mr. Whiteside, Sir Robert Kane, and other persons.

HOW THE SEED CONTAINS THE TREE.

In the single-flowering cherry-tree, which gives the most distinct illustration of the fact, the pistil is formed from two carpellary leaves, which have become succulent and united together so as to form a component pistil with a single cavity containing one young seed. Reflecting on this, in connexion with the nature of buds and leaves and minute examination of the germ bearing the plumule and radical of a bean, it appeared clear that a germ of vegetable life exists in every joint of a plant. To try this, a joint of common mint appeared the best for experiment. This was placed in water, having been cut off as close as consistent with leaving the joint uninjured at the lower end. A bud soon appeared on one side, which quickly formed itself into another joint, from which a root grew out, whilst the original bud continued to progress, and seemed disposed to show the characters of a monocotyledonous germination, assuming a green tinge at the extremity. However, a second joint formed, and another root was thrown out from it. A decided upward growth now continued, and buds and leaves were formed at all the joints subsequently developed. This would prove that every joint in a plant is a life-knot or collet, from which, under favourable circumstances, a plant or tree may be developed should it be separated from the original stem, and that it corresponds with the radical plate of a bulb, the crown of herbaceous plants, and germ from which the plumule and radical are developed in seed.

A CONVENIENT DISINFECTANT.—The most convenient, and I believe the most effective disinfectant, is chloric ether. It should be burned in a glass spirit-lamp, which is liable to the same mishaps as other spirit-lamps. Any place of the size of an ordinary room, that can be closed, can be completely deodorised and disinfected by five minutes' use of one of these lamps.—*Scientific American.*

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(*From the Commissioners of Patents' Journal.*)

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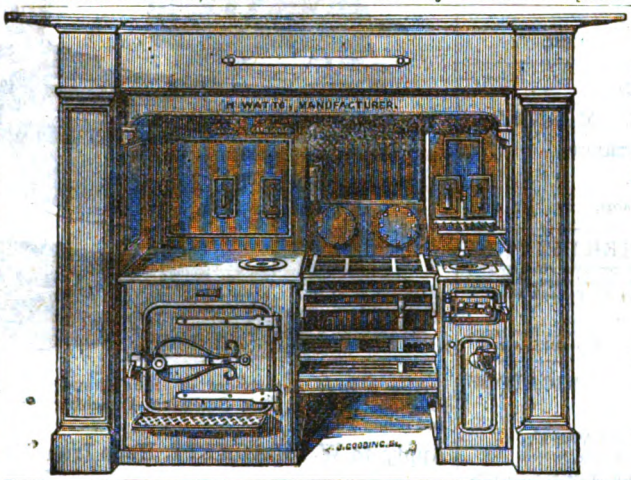

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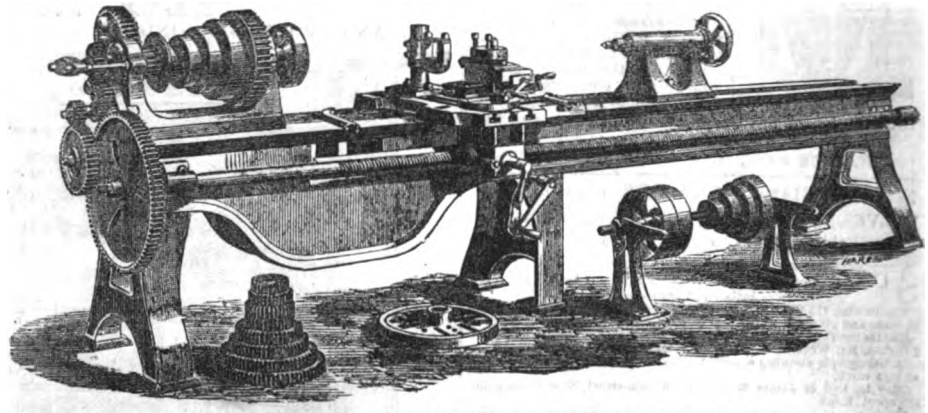

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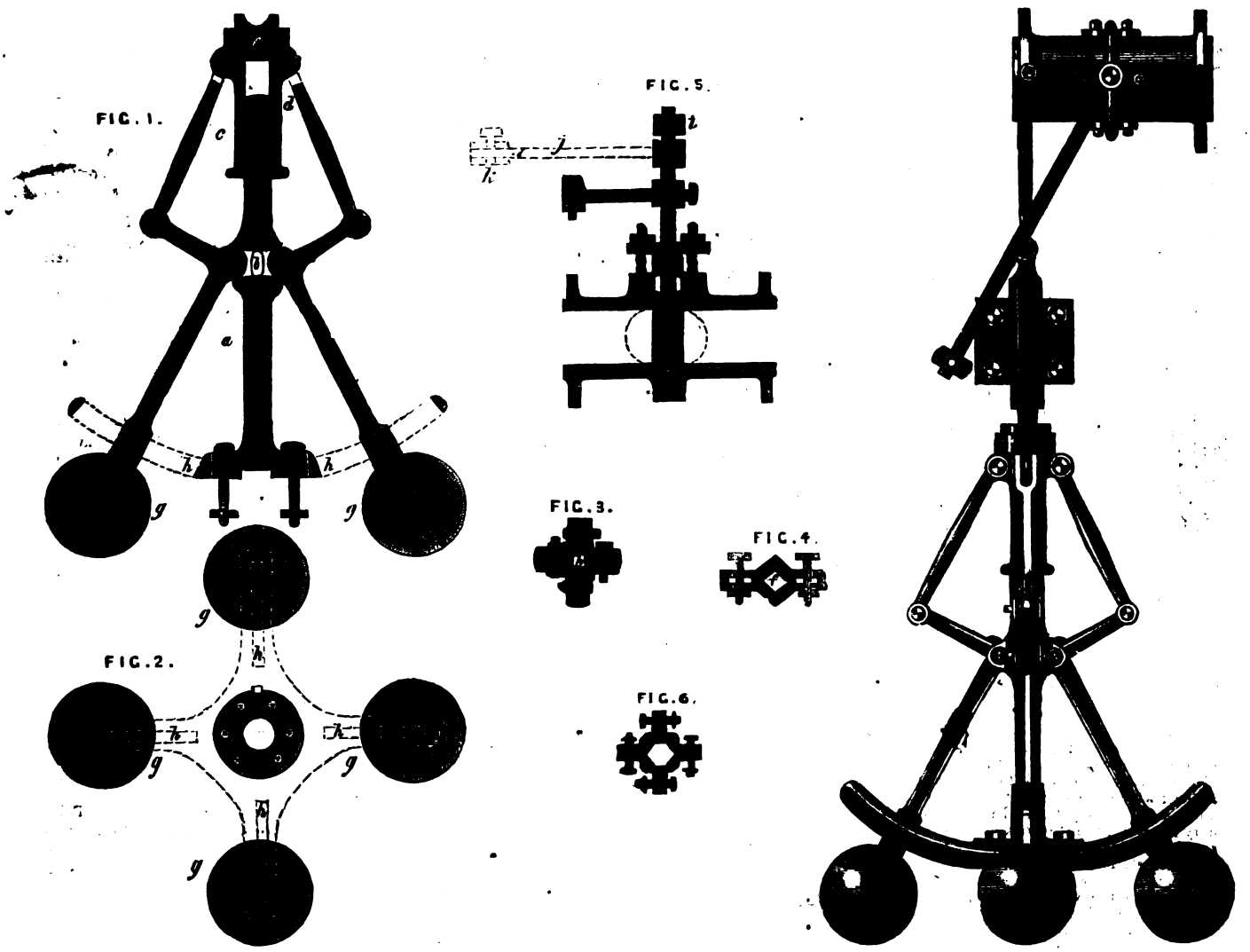

BYRNE'S ADJUSTIVE GOVERNOR.

The principle of this governor, previously slightly noticed in The English Mechanic, is, that the centrifugal force of the revolving pendulums is equilibriated at any required speed by the force of gravity of an adjustable counterweight, or the tension of a spring. The principle is not affected by the number of pendulums, but four obviously has double the power of two, revolving in the same space, besides presenting a better appearance, and a greater number would be attended with practical inconvenience; for these reasons the adjustive governor is constructed with four pendulums, each having a crank springing from the joint at right angles, which are connected by rods to a sliding cylinder having a steel centre let into the top; by these means the divergence of the pendulums raises the sliding cylinder, which, acting on the steel centre, communicates motion to the valve. It is not a condition for its efficient action that the trottle valve should be in a position shown in the diagram; but in selecting position, regard should be had for the friction and inertia of the intermediate gear; a great quantity of it impedes fine action, therefore the simplest arrangement that circumstances will permit acts best.

Fig. 1. Vertical section of the revolving portion. Fig. 2. Horizontal section at base. Fig. 3. Horizontal section of spindle at pendulum joints. Fig. 4. Horizontal section of centre guide. Fig. 5. Horizontal section of steam pipe and trottle valve. Fig. 6. Horizontal section of cylinder at joints.

(*a*) A wrought iron spindle or stalk, having a disc at (*h*), with six holes in it, to enable it to be bolted to a similar disc, on a vertical shaft of length dependant on circumstances. (*b*) A bulb forged on the stalk, having two thorough mortices in it, crossing each other at right angles, thereby forming four joints with the crack pendulums; the arrangement of the pins in those joints gives mutual security, for even if the split pin and washer of any of them flies out, the joint-pin cannot get away, because its head will come in contact with the point of its successor, which must be backed considerably before it can pass. (*See fig.* 3.) (*c*) A brass cylinder, moveable vertically on the spindle, which is made hexagon in section at that portion in preference to feather keys. There is an oil hole in the cylinder at (*d*), which must be left open, as it answers for an air passage also. (*e*) A steel concave centre driven into the cylinder. (*f*) A sliding centre, moveable vertically through the guide, the bolts of which are left extra in length, to enable it to be bolted to a bracket or stay from any convenient place. (*g g g g*) Four balls, each fixed on its pendulum by a nut fitted into a recess in the ball. (*h h h h*) Four guides forged on a centre ring, which is keyed on the disc; each pendulum is made wider at the portion which comes in contact with the guide, to present a good bearing

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surface: by that means it will not be liable to sink itself a recess in the propelling side of the guide. (*i*) A strap bolted to the steam pipe, forming a bearing for one end of the valve spindle, to take the overhanging strain off the gland. (*j*) A regulating lever, having an arc of traverse of the same number of degrees as the arc of one of the revolving pendulums. (*k*) A counterweight, which is fixed at the upper portion of the lever for the slowest speed, and fixed at the lowest point for the highest speed, the intervening points controlling immediate speeds; a spring balance may be substituted for the counterweight, by attaching it to the regulating lever and a fixed point at a convenient distance. Now admitting the engine to be working at the required speed, if it receives a check through work being suddenly put on, the pendulums lose a portion of their sustaining power, of which the counterweight will take advantage by depressing them, and opening the valve, thus admitting a greater supply of steam, which will prove a check on the error; or if the engine increase its speed through deficient work, or increase of steam pressure, the pendulums will acquire more centrifugal force, consequently increase their angle of divergence, raising the counterweight, and closing the valve, thus reducing the supply of steam until the increasing speed is effectually checked. It is evidently instantaneous in its action, for the counterweight keeps a continual pressure on the steel centre, therefore the immediate gear is always tight, so that the slightest variation of the pendulums is at once communicated to the valve. It is advisable to gear it to revolve at a speed high enough to cause the normal angle of divergence of the pendulums to be at least 90°, but it may be geared at a much higher speed with advantage, the only limit being the strength of material in its construction; hence its power can be increased to suit circumstances, and it becomes more sensitive to an error by gearing it at a high speed, and using a correspondingly heavy counterweight. Its capacity for maintaining various speeds will often prove advantageous, especially to the smaller class of engines, where the nature of the work sometimes requires a higher speed than at others; the adjustive governor gives full scope for any such alteration of speed, as the length of regulating lever allows that its maximum number of revolutions shall be double its minimum; the numerical range being determined by the size of the counterweight, it can be made heavy or light to suit the boiler power. From this it may be seen that the higher the range of speed required, the more the regulating lever must be weighted, consequently the revolving pendulums become more depressed, which is rather anomalous; but as the regulating lever gives a gradually increasing weight on being raised, the same amount of centrifugal force cannot raise it to the same height when the weight is heavy as when it is light, consequently the lever not being raised, the valve remains open to a greater extent, admitting a greater supply of steam, which gives the higher speed. Its advantages over the ordinary governor can scarcely be questioned, when it is so well known that they are never trusted with the command of the steam; with the present one this is not so, it must have the steam at its disposal, and in sufficient quantity as to be able to counteract any possible check which the engine may receive through work being suddenly put on. In engines with the ordinary governor, the stop-valve is the regulator of the speed; and when the work is very variable, it is necessary to station an attendant by the stop valve to give more steam when the work is put on, and reduce it when the work slackens, otherwise the engine would be either brought up, or increase its speed to such an extent as might damage the machinery. The adjustive governor proves a more effectual regulator than any attendant can possibly be, for by its sensitiveness and power, the instant an error occurs in the speed, the trottle valve is moved to such an extent as effectually checks it. Errors there must always be, for it is the very fact of a variation of speed which brings the governor into action; but if errors cannot be prevented, the governor can be made so sensitive as to be applying the remedy in the same instant that the error commences, thereby reducing the possible variation of speed within so limited a compass, as to be almost imperceptible, and undoubtedly sufficiently uniform for all practical purposes

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DAVID SLOAN THOMSON.—Received.

T. A.—Information in any London Directory.

TIN FOIL.—Through any wholesale house.

C. SIMPKINS (Reading).—The apparatus was illustrated in a recent number of the *Journal of the Society of Arts*.

F. G.—No. 16, Bucklersbury. We think Naylor's good, and should give them preference.

HYDRO PNEUMATIC.—Your theory is correct, but far from possessing novelty.

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A McGEE.—Received. Answered by other correspondents.

H. M. (Greenwich).—Advertise in the *Illustrated Builders' Journal*. Thanks for your communication, but "A Draughtsman" has already been answered.

DAVID KNIGHT.—Thanks for the information sent. We are about to crowd in for want of space. Other letters will be noticed early.

W. J. D. E.—Look at pages 105 and 106 of "Tate's Mechanics," and at page 62 of Chas. D. Abel's work, in Weale's series, you will find all you require.

DRAUGHTSMAN.—Look at page 334 of Vol. II. of the *Chemical News*, you will find the receipt.

T. H. B.—Try strong acid and water.

JOHN TURNER, of No. 32.—If you mean coloured flames, see Vol. I., page 41, and Vol III., page 144, of the *Chemical News*.

T. G. (Darlington).—You are perfectly correct in judging that the answer "received, but unable to spare space" referred to your own letter. Mr. Wegg's letter was inserted as a communication only, and not as an editorial article, and we must beg you to address your complaints to Mr Wegg at his private residence. We are perfectly willing to insert any communition on the subject forwarded by Mr Slugg himself, but we object to letters by deputy, and decidedly consign them to the waste paper basket, when they assume the appearance of free advertisements.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

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TO OUR READERS.

We have recently received many letters from cabine makers, mathematical instrument makers, joiners and others, complaining that we set apart no portion of THE MECHANIC for articles and correspondence on their especial trades. We beg to inform our readers and correspondents that our columns are open to communications from workmen of every description—the more the merrier—but they must be of a strictly practical character.

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IT often happens that, with all the accommodation necessary for the purpose, the amateur and workman is often at a loss for a knowledge of the wherewithal to accomplish the purposes above noted. Though in various articles published in our columns there might be picked out information on one or two points connected with our subject, still enough has not been given in the lump to serve as a sufficient guide. A correspondent, labouring under the same impression, has forwarded us a long communication, from which we eliminate the following:—For polishing and blueing screws the materials are:—Screw head tool and chucks, one smooth and one old 5-inch pottame file; a smooth-cut file burnisher, 5 inch; a strip of "arcanser" oil-stone; screw-head files, according to size of screws; a strip of greystone, one of bluestone—each about 6-inch long and 1-inch square; strips of iron and bell metal, 6 inch long ¾-inch wide, ¼-inch thick; a smooth-cut knicking

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file, a piece of brass 2-inch diameter, thin, with 5-inch handle; a piece of brass, ¼-inch thick, ½-inch diameter, with holes the size of the taps of screws; small quantities of oilstone powder, sharp crocus and red stuff, also fine red stuff, but not too fine; strip of dogwood, 6-inch long, 1-inch square; French buff; small quantity of finest flour emery; a good spirit lamp; cleaning-off medium, or prepared bread. (For this, take a bit of bread, size a walnut—dip it in clean water; squeeze water out; knead up before the fire or in spirit lamp, but do not scorch, only drive out superfluous moisture, and make a dryish dough; keep in a porcelain box). To polish screws (soft):—File screws up to shape, polish first with greystone, and oil and finish with blue-stone and oil; clean off with the bread, wipe the moisture off with piece of leather; clean the burnisher on the board with emery, taking care no emery remains on the burnisher; rub the head of the screw, gently pulling the bow one way only. If the screw is large, and the burnisher scratches, rub a little wet soap on the burnisher; you can then rub hard, and pull the bow both up and down. Having polished and burnished the screws, bread off the oil, throw them in some slaked lime; then brush off the lime, place the brass with the holes in it on the blueing pan, and place not more than one screw at a time thereon; hold the pan over the spirit lamp or gas jet, taking care there is no current of air setting towards the same, and that the flame is equal round underneath the pan, for otherwise the screw will not colour equally. If the screw be large, and a good blue is desired, it must be taken off a little before the required colour appears. To polish and blue hard screws: place the screws, two or three at a time, on a piece of charcoal, and blow to a bright red with a blow pipe flame, drop them in some oil; after hardening, bend a piece of bending wire, so as to hold the screw with some oil; hold it in the flame until the oil takes fire, remove it, and, as soon as the blaze dies off, drop the screw in the oil. (Care is required, or the screw will be too soft, or dangerously hard, though, from some purposes, screws are polished quite hard.) Place the screws in the tool, polish with "arcanser;" if the edges are showing, do them with iron and iolstone powder; next, a piece of soft wood and oilstone powder—the powder having been mixed with just as much oil as it will absorb. Mix, also, the sharp and fine red stuffs as thick as they can be mixed, on steel blocks sold for this purpose, to be kept clean. Having polished out the file marks with oil-stone, file clean with smooth file, and the bell metal; use small quantities of sharp stuff, or the iron can be used; this brings a polish ready for the bell metal and fine stuff. Next, file the surface off the dogwood, put on a very small quantity of fine red stuff, rub the screw a few times on it; this gives finish and colour, and a better blue will take on blueing, as before. A piece of good clean wick is a good thing to use for placing the red stuffs on the polishers; elder pith to further clean the heads, to enable the polisher to see the progress made. All the tools are readily to be had—for instance, from Grimshaw, of Goswell-street, London; or from Swinden, in Temple-street, Birmingham. Screw-head tools range from 7s. to 15s.; bell metal, 1s. 4d. per pound; oil-stone dust, 8d. per pound; red stuffs, 8d. per oz.: pith bundle, 2s.; dogwood, in sticks, 2d. to 6d. each; and glossing stuffs, in boxes, 8d. to 3s. each, according to size.

CHEAP GAS.

FOR years, many years, the quality of the gas supplied to the consumers of the metropolis has been wretched—compared with that supplied to many other towns; and for this article an extraordinarily high price has been paid, the minimum being now 4s. 6d. per 1,000 cubic feet. At various times spirited individuals have endeavoured to organize opposition to the various companies, and have failed from want of support; interested promoters have "got up" companies after copious preamble, have pocketed "considerations," and allowed their promising "opposition" to collapse, and a reliant public to be—well, to use a mild term—rendered distrustful of any more such schemes. Still, it remained a fact that the gas was bad and dear, and that it could be had both better and cheaper.

The Corporation of London, after a deal of humming, and hawing, have arrived at the same opinion as their *clientelle*, and have determined to make gas for the City. Accordingly, application is to be made to Parliament for all the necessary powers in the ensuing session.

Many efforts have been made to prove that, owing to various circumstances—never very clearly set before the public—it was impossible to make the gas either cheaper or better: whence these statements emanated, required no very little difficult guess work. Yet it is a remarkable fact that no man of our acquaintance has ever yet been able to get at the exact dividend paid to the holders of gas stock, though there is no doubt about its being a very good one, and, evidently, the Corporation of London are of opinion that a much less will pay for their proposed venture. Signs are not wanting that, afraid of the Corporation, the companies are coming to their senses, are willing to give up an immense share of their profits to the public, with a promise of more. From Christmas the price will be reduced by the City Company from 4s. 6d. to 4s., and "the directors anticipate the increase in the demand for gas consequent on this reduction will enable the company, at no distant period, to effect a further reduction.'

If the companies think that by this concession the Corporation will be deterred from pursuing their scheme, we are inclined to believe they will find themselves very far mistaken. Quite as much, also, as they will find it impossible to compete with the Corporation in the manufacture of the article. Because the Corporation works are intended to be erected down the river, where land is cheap, compared with what it is in this city's vicinage; the cost of coals laid down at the works will be considerably less, and advantage will be taken of the very latest improvements in gas-making, combined, we believe, also with self-charging and discharging retorts. And here we would advise such of our readers as have improvements in hand, we know several have, to keep their eyes open, and at the proper time, place themselves in communication with the City officials.

In competition, we have as good a guarantee for quality as under monopoly; most decidedly, we have a superior one for price and for quantity. And, viewing the matter in this light only, we wish all success to the Corporation—though we should have the streets up for the next three years! and a due quantity of comfort and solace to the various stock and shareholders in the existing companies under the reduction of their dividends and bonuses.

COMBINATIONS OF THE STEREOSCOPE AND THE PHENAKISTISCOPE.

MR. A. CLAUDET, in a paper on moving photographic figures, illustrating some phenomena of vision connected with the above combinations, by means of photography, says that from the beginning of photography it must have struck those who were acquainted with the phenakistiscope, invented by Plateau, that photography could produce with advantage series of pictures for that instrument with greater accuracy than any made by hand. When, at a later period, the stereoscope had become popular, there was a still stronger incitement for desiring to make use of that process to produce binocular pictures for the phenakistiscope in a way to combine the stereoscopic effect with the illusion of moving figures. M. Duboscq made some ingenious attempts in this direction, however not perfect; for in his revolving disc the two series of pictures do not move with the same velocity on account of their being placed on two zones of different peripheries, which produces a sort of confusion and distortion in the representation of the object during its movement. In his revolving cylinder, this defect does not take place; but the pictures being curved like the cylinder is a most unfavourable disposition for examining them in the stereoscope. About the same time Mr. Claudet had also turned his attention towards the subject, and had practically experienced the difficulty of obtaining together the phenakistiscopic and stereoscopic effects without similar defects. The instrument was first exhibited to show how easy it was to obtain the illusion of moving figures without stereoscopic effect, two pictures being sufficient to elicit the phenomenon, although the illusion of reality suffers from the abruptness of two extreme movements, and from the deficiency of intermediate positions. Nothing, however, is easier than to employ eight different pictures in as many different stages of the action: and with this number the effect will be sufficiently complete. For this, Mr. Claudet, having placed in his stereoscope two separate cubic frames, has only to fix on their four sides, at right angles, two sets of four pictures, making eight pictures, which are made to pass in consecutive order before the lenses, and the figure assumes consecutively eight different stages of the whole action. The instrument in its simple state, with only two pictures, will suffice to illustrate the principle, and, at the same time, elicit some curious phenomena of the perception of vision. It is well known that the retina has the power of retaining for a short time the impression or the sensation of the image which has struck it. Availing himself of this property, Mr. Claudet has constructed an instrument in such a manner, that by means of a slide, with one hole, he can, by moving it rapidly in a reciprocating horizontal direction, shut one lens while the other remains open; and in continuing that motion, while one eye sees one of the two pictures, the second eye cannot see the other picture. If, before the sensation of one eye is exhausted, the slide shuts one lens and opens the other, a new impression is produced on the retina, and we have an interrupted sensation of vision as if the object had been moved before us; and if a sufficient number of pictures represent that object in the various consecutive positions it has assumed during several stages of its motion, we experience on the retina the same sensation as we have when we see the object itself while it is moving; and although the pictures in their limited number do not and cannot show all the intermediate positions of all the stages of a continuing action, still the mind has the power of filling up the deficiency, as it does, if, when looking at a real object in motion, we accidentally wink the eyelids, or an obstacle happens to pass between us and the object. To exemplify this, Mr. Claudet has constructed two pictures, one representing the beginning of an action, the other the end. By moving the slide one way, the right eye can see the pictures representing the figure in one position, while the picture showing the other is invisible to the left eye; then by moving the slide the other way, the left eye sees the figure in the second position, and the first picture is invisible to the right eye. Although we have really only seen the figure in two extreme positions, still we have had the illusion of having observed the intermediate positions—as, for example, in a slide exhibited having one picture of a boxer with his arm close to his side as preparing to hit, and another with the arm extended delivering the blow. Here, although all the intermediate positions are omitted which must have been assumed during the act, the mind completes the action. Another curious phenomenon of this alternate vision is that one cannot distinguish which eye the object is seen by.

HARDENING AND TEMPERING STEEL.

THOUGH at different times we have directed attention to this matter—only the other day giving some common examples—we continue to have inquiries on the matter poured in upon us; showing, either that our pages are not carefully looked over by some correspondents, or that something more is required from us. We incline to the latter opinion. To do justice to the matter we have to cull from various sources, and if we do not specify names, it is because we fancy real authorities on mechanical subjects do not care so long as their really useful knowledge is disseminated among those who most require it. All we ourselves contribute to the general fund the general public is welcome to, whether the name of our journal be appended thereto or not, provided those who use it may not claim it as their own.

In this matter there are various points on which all may be said to agree; thus, that scale should be removed from the face of the work, to expose it more uniformly to the effect of the cooler; that the temperature suitable to forging and hardening steel differs with its quality and mode of manufacture—the heat diminishing with the increase of carbon; that coke or charcoal is much better than coal as a fuel—owing to the presence of sulphur in large quantities in the latter; that the lowest available temperature should be employed in each process, the hammering should be applied in the most equal manner throughout, and for cutting tools it should be continued until such are nearly cold; that hardening a second time without the intervention of the hammer is attended with increased risk; and that the less frequently steel passes through the fire the better.

The smallest works are heated with the flame of the blowpipe, and are occasionally supported on charcoal. Those objects which are too large to be heated in this way, and are yet too small to be conveniently treated in the naked fire, have various protections. Thus a sheet-iron box stuck into the middle of the fuel is both safe and cleanly, and in many cases the addition of red fuel *in the box* is of great value. The work in then governed with long forceps. For long and thin tools, such as engravers' tools, &c., a crucible or an iron pot, from 4 to 6in. deep, filled with lead and heated to redness is used, and in this the tools are placed — moved about in the mass to equalise the heat. Occasionally a pan of charcoal, powdered, is placed on the fire, and heated to redness, and in this the articles are placed. Many tools are heated in the ordinary forge fire, but this should then consist of *cinders* in preference to all coal:

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furthermore, the bellows should be used previous to the introduction of the work, and plenty of time allowed to get hot. The Sheffield folks use coke both in forging and hardening steel goods. They frequently prepare it for themselves either on the forge hearth or in the open yard. Whichever method be followed, all the parts to be hardened should be brought to a uniform temperature, and this is only accomplished by moving the work through the fire so as to expose all parts alike to it action. The fire is increased in size according to the size of the work. In our opinion practice is the great guide in the matter, and that the learner should acquire his experience not with all sorts of work, but begin at small and proceed gradually upwards—or, as the Scotch song says:—

"Creep awa' my bairnies;
Creep before ye gang."

Mr. Holtzapffel, in his excellent work says. "It is argued by some, that by heating pieces of steel to different degrees, before plunging them into the water, the one heat attains full hardness, the next the temper of a tool fit for metal, another of a tool fit for wood, a fourth that of a spring, and so on. That this view is not altogether without foundation, appears in the fact that if the end of a piece of steel be made entirely hard, the transition is not quite immediate from the hard to the soft part; and Mr. Ross, in making the dividing points for his dividing engine, hardens the end of a longer piece of steel than is required, and forms the point upon the grindstone, exactly at that part where the temper suits, without the steel being let down at all; a practice first employed by Mr. Stancliffe, a workman formerly employed by the celebrated Ramsden. The hardening by this method however without tempering the scale is confined within such extremely narrow limits as to be nearly useless; thus, it frequently happens that in a number of tools heated as nearly alike as the workman could judge, some few will be found too soft for any use, although they are all intended to receive the ordinary hardness; so as to require letting down, as usual with those tools exposed to violent strains or blows, as screw-taps, cold chisels, hatchets, &c., although many tools for metal, used with a quiet and uniform pressure, are left of the full hardness for great durability. With *excess* of heat, below *the lowest that will suffice*, the brittleness rather than the useful hardness of tools is increased; and when *no excess* of heat is employed beyond that *absolutely requisite* for hardening in the usual manner, the steel does not appear to be injured, and the colours on its brightened surface are an excellent, and in general sufficiently trustworthy, index of the inferior degrees of hardness proper for various uses." It should further be noticed that less than a certain amount of heat not only does not produce hardness, but, in the opinion of many intelligent workmen, has a contrary effect; but this, we opine, is only true with certain qualities of stuff, and sufficient observation has not been made to determine *which* with certainty; consequently, with this opinion of the effect, these workmen resort to it as the means of rapid annealing,—not by plunging the steel into the water, and there al owing it to remain till cold, but dipping it quickly, then holding it a few moments in the stream, again dipping, and so on, reducing it in a hasty and intermitted manner to the cold state. And this brings us to the cooling.

In cooling various mediums have been resorted to —currents of cold air, water in various states, oil or wax; and freezing mixtures, flat metallic surfaces, and mercury have been used. Stoddart recommended water of 40°. It appears to be allowed that steel cooled in mercury is the hardest, next that plunged in salt and water, or water treated with acid; next plain water, and lastly oils. Mercury is a good conductor, and the nonformation of steam keeps the two surfaces in contact, which is not the case with water. File makers doctor their water, with what is a secret, though we more than suspect they use in some cases salt, and in others a pinch of white arsenic. By the way, we once saw a bronzist put a pinch of fine salt into his crocus mixture, and though he could give no "reason why," yet he maintained it materially affected the quality of the work after it came from the hammer, and there was no doubt whatever about the man being a first-class workman. Respecting water, many are in favour of using that which has been used over and over again even for years, provided it is not greasy, and when the steel is harsh the chill is first taken off it to lessen the chances of cracking. It is much to be desired that some one would analyse the water used in various large establishments—each in its fresh state, and also when it is supposed to be in its best working condition,—notice being taken of the character of the steel produced after passing through each. We think many doubts would be set at rest by this.

The so-called natural spring of John Oldham, who was engineer in his day to the Bank of England, was used by him in hardening the rollers for transferring the impressions to the steel plate for bank notes. This spring consists of a vessel with a true and a false bottom, the latter perforated with small holes; it is filled with water, and a good supply is admitted below the partition, which ascends through the holes, and pursues the same current as the heated portion, which also escapes at the top. We do not know that any one now uses this contrivance, but it may be found useful.

Occasionally, when neighbouring parts are required to be respectively hard and soft, collars are fitted tight upon the work, to protect the parts intended to be soft from the direct action of the water.

But the process of hardening is altogether one of anxiety, as the sudden transition from heat to cold, if it does not often crack the work, frequently distorts it. This latter is the accident which most frequently occur to larger pieces, which may be said to harden in layers; thus, though the outside may be perfectly hard, as the centre is approached it will be found less and less hard Often, hours after heavy work is removed from the water, it w ll crack with a loud report—and it is almost therefore a certainty that the inner part continues to contract after the case is fixed Again, the contiguity of thick and thin parts is highly dangerous, but the mischief which ofttimes follows their cooling may be avoided, or rather lessened, by binding pieces of metal round the thin parts. So also angular notches are sources of mischief. But, generally, it may be said that the frequency of both cracks and distortions is lessened by the successful management of each step in the manipulation—the original manufacture, and the forging, for instance, so that the mass be equally condensed throughout on all sides. Further, when red hot it is weakest, and liable to accident through incautious handling, and from meeting the cooling medium irregularly; so it is best to plunge the work vertically, for thus less disturbance is risked than when immersion is accomplished in any other manner. Scale should *always* be carefully removed before hardening, otherwise the water or other cooling medium cannot exercise an equal power. Edges should be left thick, and grinding supplement the hammer.

Respecting the heat for tempering, it is well known that between the extremes of hard and soft there are many grades, the most common index for which is the surface. These tints have been given by Mr. Stoddart as under:—

430 deg.	Tools for metal	very pale straw yellow
450 "		a shade of darker yellow
470 "	Tools for wood & screw taps, &c.	darker straw yellow
490 "		still darker straw yellow
500 "	Hatchets, chipping chisels and other percussive tools, saws, &c.	a brown yellow
520 "		a yellow, slightly tinged with purple
530 "		light purple.
550 "	Springs	dark purple
570 "		dark blue
580 "	To soft for the above purposes	pale blue
610 "		still pale blue
630 "		still paler blue with a tinge of green

The first tint is only seen by comparison with a piece of steel not heated. The heat for tempering being moderate, it is often supplied by that part of the tool not required to be hardened. The workman quickly applies a file to test the hardness, then brightens it here and there with an emery stick to watch for the colour; and when this is attained the work is cooled in such a way that the body of the tool may not supply any more heat.

One method of tempering small objects gives rapidity, but it requires dexterity and quickness on the part of the operator. A few inches of the end of a flat bar of iron about 2 feet long is heated to redness, and laid across the anvil or fixed by its cold end in the vice. The work is placed on that part of the heated surface of suitable temperature, gradually sliding the work towards the heated extremity.

The correction of distortions is effected by means of the hammer at the period of letting down; and this should be done upon the anvil with the thin pane of an ordinary hammer. The blows are delivered on the hollow side of the work at right angles to the length of the curve, thus the concave side is gradually elongated, and the plane surface gained. We will return again to this matter.

COOK'S RIVETTING MACHINES.—Messrs. D. Cook and Company, Engineers, Glasgow, sent away last week three of their patent steam rivetting machines, one of them for a marine engineering firm in Bremen, and two of them to the order of a large engineering firm in London. These machines are made when required to punch, shear, and rivet; they are made to rivet either horizontally or vertically, and are well adapted for girders and cylindrical or square boilers.

ON THE ENGINEER'S SLIDE RULE.

(*Continued from page* 104.)

I am now in a position to explain more fully the difficulty generally experienced in reading off the numbers obtained by the different processes.

It must be borne in mind when dealing with the numbers marked on the rule that although they are arbitrary and hence for the time being we can call them what we like, yet we cannot positively alter their true values, but must always account for the assumed values in the results we obtain; thus, if we call 2, twenty, and multiply by it, our result will be ten times too much, and therefore in valueing such a product we must always remember to omit the terminal cypher. On the contrary, if we have to multiply by 20, and only really take twice the quantity, our result is evidently ten times too small, and hence we must not omit to add a cypher to our results. This borne in mind, suppose on our rule we had to multiply 25 by 35, we should take 2 and 5 of the long divisions on A, and call them 25 (while in reality they are only 2·5), and setting this point against 1 on B, then finding 3 on B, and calling it 30, with five of its longest divisions we call that 35 (though really 3·5), and against this number on A, we find 8 and 7½ divisions, which expressed in numbers is 875, and to value this number we must bear in mind that in both multiplier and multiplicand we divided by 10, hence in the result we must account for that suppression, by again multiplying by two powers of 10, that is 100, making the product instead of 8 75 equal to 875. This operation, simple as it may appear, is a great one, in fact, the chief difficulty in the way of a beginner, but like all other obstacles it can be got over by perseverance.

As previously stated, multiplication and division form the basis of all calculation, and the first instance in which they are used in their combined form is in what is termed "proportion" or the "rule of three," and as in multiplication and division the lines A and B only are used, so also in this combination the same lines answer all questions.

In this rule three numbers are given to find a fourth, and it will always be found that two of the given numbers are alike in kind, the remaining one being of the same kind as the one sought for, this single term must be found upon the line A, then we consider whether under the given conditions the answer should be more or less than this unpaired term, if more, we set the least of the paired terms under it on B, and the answer will appear against the *greater* on A, but if the answer must be less, we set the *greater* of the paired terms on B against the odd term on A, and against the lesser term on B will be found the answer on A.

Hence we see that the odd term and the answer always appear on A, while the paired terms must be found on B, and by duly considering the parts these terms play in the operation, and assigning to each its proper place, the rule of three, whether direct or indirect, is performed by the same operation without requiring us to reverse the slide (as is usually taught) making a distinction where no absolute difference exists.

As an example, suppose 7lbs of iron cost 11d., what would 28lbs. cost? Here we have 7lbs. and 28lbs. both alike in kind, and an odd term 11 pence, which will be of the same kind as the answer, consequently we take 11 on A, and we see at a glance that 28lbs. of any material will cost more than 7lbs., hence we place the 11 on A against the least term 7 on B, and opposite the remaining term 28 on B, we find 44 on A, the price in pence of the 28lbs. of iron. Again, if 4 men can do a piece of work in six days, how long should 8 men be doing the same work?

Here 6 days is the odd term to be found on A, and it is evident that 8 men could do the work in less time than the 4 men, hence we place the 6 on A against the greater term 8 on B, and against the other term 4 on B, we find 3 on A the answer sought.

The next step forward is "the square and its root." The square of a number is the product of such number multiplied by itself, thus $4 \times 4 = 16$; here 16 is the square of 4, and 4 is the square root of 16.

Now in all cases where the square of a number is concerned, the index of its power is 2, hence the logarithm of any number being multiplied by 2 gives the logarithm of the square of that number, and if we examine the lines C and D on our rule, we find as before stated that all the divisions on D are exactly twice as long as those upon C, consequently if we find any number upon D, its square will appear upon C, and *vice versa* if we take any number upon C, its square root will appear upon D.

* Contributed by Mr. W. Tonkes.

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and it is for this reason that the line D is divided as a single radius while the other three are made double.

The principal use to which the square and its root is applied, as connected with the slide rule is to find a mean proportional between two given numbers, or to find the side of a square that shall contain the same number of units of measure as any given parallelogram.

Thus supposing we had a plate of iron 8 inches long, and 2 inches wide, its superfices would be 16 inches, now we want to find the side of a square that would contain exactly the same number of inches in area, and that will be the mean proportional.

To do this on the slide rule we set the 2 on C, to the same number 2 on D, and against 8 on C is 4 on D, the number sought for, if we multiply 4 by 4 it gives 16 inches, the same area as the parallelogram 8 inches by 2 inches.

The next step onward treats of "the cube and its root." The cube of a number is its product when multiplied twice into itself, thus $4 \times 4 \times 4 = 64$ the cube of 4.

To find the cube of a number on the slide rule we set the given number on C to 10, and against the given number on D is the cube on C; but in finding the cube root of a number our slide rule to a certain extent fails in that simplicity and certitude which characterize all its other operations.

The method is this, we invert the slide, bringing the line B against D, then setting the given cube number on B against 10 on D, we look along the rule till we find a number on B exactly coinciding with a like number on D, such number will be the root sought, but it is evident that unless the root is an whole number, considerable difficulty will be experienced in finding the correct root among the minor divisions, especially as they have to be estimated backwards in consequence of the slide being inverted. It must, however, be remembered that from the nature of its construction the slide rule was only designed to deal directly with involution or evolution, so far as the second power or square was involved, and the fact that we can by any means adapt it to do more than that for which it was designed is only another striking proof of the immense versatility of its powers as a calculating machine.

I now come to the application of the foregoing rules to the various purposes in which they become useful to the mechanic. The lower leg of the slide rule is covered with a great number of figures together with a collection of hieroglyphic F's and I's and sundry other abbreviations, the whole being generally described as a table of "gauge points," but in no work that I have yet seen can I find a lucid description of "how" these gauge points are obtained, or "why" they should be used in the manner described in the rule books generally published, and since at least half the value and the whole interest of mathematical enquiry is lost when the aspiring pupil is deprived of the *why* and *wherefore* of his operations. I will endeavour to show briefly as possible whence these mysterious "gauge points" are derived, and then proceed to a few instances of their application.

(*To be continued.*)

THE ENGLISH MECHANIC.—HIS RISE PROGRESS.*

The subject I have chosen for my brief paper may seem a rather egotistical one, for I mean to speak of ourselves, and of our own and kindred institutions. Possibly I may be excused for my temerity, even by those who have not always shown themselves favourable to this Association, and who, indeed, have orally, and in print, endeavoured to depreciate it in the eyes of the scientific public. It happens that I stand in a position apart from the circumstances which surround most of my brother members, and am, therefore, enabled, I think, to speak dispassionately, and without bias, of the progress, prospects, and usefulness, or otherwise, of this society. My long and intimate connexion with it enables me also to advance my opinions with the confidence which results from experience, although not, it is to be hoped, in any dictatorial spirit. I may say at once, then, that in my mind there is no doubt as to the usefulness and value of such associations as our own, not only to the class of men who are eligible for membership, but to the classes which are immediately above and immediately below that class—employers and workmen—as well as to the general community.

In order to demonstrate the grounds upon which I justify "the faith which is in me" on this point, and to fortify myself for its defence, it will be necessary for me to glance at the history of mechanical engineering in this country during the past half century, and to endeavour to assign to the foreman engineer his true position in regard to it. It is not needful to expatiate upon the wondrous mechanical triumphs which have been achieved during the period named. They are patent, not only to those who have shared in effecting them, but to the public who have partaken largely of the advantages resulting from them, and who every day find life made more and more enjoyable through their existence. When the advancement made of late years in the invention and construction of labour-saving machinery is taken into account, when the locomotive is found puffing its rapid way across rivers, through tunnels, over mountain gorges, and in fact defying geological eccentricities, and the obstacles which nature appears to have provided only in order that man's God-given skill and industry may remove them; when the noisy paddle or the noiseless screw is seen propelling that marine locomotive—the steam-boat—in the teeth of the most violent gale, and over the most stormy sea, and carrying its living freight, and its dead stock of merchandise almost from pole to pole, in safety; when the sharp click of the sewing machine is heard in the cottage, and one knows that it is ministering to the moral and the physical good of its attendant, as well as to the comfort and convenience of all; when these and a hundred other mechanical glories which might be enumerated are considered, I say that the engineer and the artisan may well congratulate themselves, and, without self-pride, thank God that they have been privileged to assist in effecting them. "He's only a mechanic," is an expression sometimes used in disparagement of the man who week in, week out, pursues his modest calling, and who eats no bread but that which he has toilingly earned. *Only* a mechanic! why, where would England be at this moment but for its mechanics, past and present? It is not necessary to summon up as witnesses in favour of the mechanical class the spirits of Watt, of Rennie, of Neilson, of Bramah, of Huntsman, of Maudslay, or of other giants who have passed away, for we have among us now worthy followers of those illustrious men, whose names are known to you all, and who are creating for themselves niches in the gallery of fame beside those of their predecessors. *Only* a mechanic! I can say for myself that I rejoice in being a non-commissioned officer in the ranks of the mechanical army of Great Britain, and in having been permitted to share—however humble the duties entrusted to me may have been—in the great work of improvement and of civilization in which it is constantly engaged.

I predict that the time is not far distant when the mechanic shall receive fuller and more honourable acknowledgment than he has ever yet obtained; when those who enjoy privileges, and comforts, and advantages inestimable, which are traceable directly to his agency, shall at least admit his merits, and no longer taunt him with presumed inferiority.

In effecting those vast onward strides in every branch of mechanical industry which have been made in England since the dawning of the present century, it is easy to discover the fact, that the impetus has been derived not alone from the action of the few, but the combined influence of the many. I venture to say that there is scarcely an invention of an engineering nature in practical use at present which owes its existence to any one man. It is possible that the idea of a contrivance for accomplishing a certain purpose may have been the production of one fertile brain, but in its realization, in the perfecting of details, in the surmounting of practical difficulties, in short, in the *working out* of the scheme ninety-nine times in the hundred the inventor is indebted to others for suggestions, and even more tangible assistance. It is not for me to detract from the merits of those remarkable men who stand out prominently, who shine as "bright particular stars" in the mechanical firmament, and cast a portion of their lustre on their fellows, but it must be permitted me to say that some portion of their light, like that of the moon, is borrowed.

To their assistants of each grade they owe something; and although those assistants may not be fortunate enough to find a *Smiles* for a biographer, and may die "unwept, unhonoured, and unsung," yet have they been useful to their employers, and in their generation, and their claims to acknowledgment cannot be ignored. It is not long since, on a very happy occasion, when certain clouds, which for a time overshadowed us, were not visible, and which clouds have now dispersed—it is not long since that Mr. Penn stated that "a good foreman engineer was the *right hand* of his employer." My own knowledge of the profession, and my acquaintanceship with numerous representatives of both the classes named by our excellent and generous friend, enables me to state that in making the remark he spoke what is emphatically the truth. I go further, however, and say that the foreman engineer not unfrequently constitutes a portion of a more important organ of his employer's body than the hand—namely, the head. Let it not be understood for a single moment that I say this offensively; I have no such intention—far, very far from that. It is merely by way of an extension of Mr. Penn's simile that I venture upon the remark. The foreman engineer, I wish to show, has to think as well as to act. He must not only have used his hands but his mind to some purpose, or he would not have obtained the dignity attaching to his post. There is no royal road to foremanship with which I am acquainted. The heights of office must be reached by the use of mental scaling ladders, and by industrious climbing; and they are only to be retained possession of by constant watchfulness and unwearying exertion. No foreman engineer with whom I am acquainted ever received his appointment from mere favour. It is true there is no Dean's-yard Council sitting, in a torture chamber, for the purpose of testing his knowledge of matters which it is *un*necessary for him to have learnt; but before being admitted to his office, the foreman engineer is invariably put through a far more efficient ordeal. He must have displayed a sound practical acquaintance with his art, he must have proved himself a good workman in the various branches of his profession, he must be a draughtsman, possess commercial abilities, and understand thoroughly the nature, characteristics, and cost of the materials to be used under his direction. Beyond and above these qualifications, the candidate for foremanship in an engineering establishment must comprehend the scientific theory upon which all engines and all machinery are based, the laws of nature which govern their action, and, in addition, he must understand *human character*, so as to control with temperate firmness and discretion the workmen who are to be placed under his direction. And these are only a portion of the requirements of a foreman engineer; and no doubt many who are listening to me now could draw from the varied notes of their own experience many more illustrations of his necessities supplementary to my own.

Now, it is in the *workshop* that the would-be foreman must acquire and exhibit the talent which is to warrant and justify his promotion. *That* is the university in which *he* must graduate, and in which he must earn his degrees. In the workshop he must obtain his honours, and there he must develope his latent powers. No *examining* process will enable him to avoid the *plucking* which sometimes befalls candidates for the Civil Service, or sustain him under the pressure of constantly changing duty. It is only by the plodding and persistent pursuit of information, and the determination to surmount difficulties, that he may hope to rise, or to sustain himself when he has risen, from the ranks of his fellow-workmen.

If I rightly understand the principles of this Association, and of those kindred institutions of foremen engineers which have happily come in to existence, and which are flourishing, I am glad to say, in Manchester and Leeds.

(*To be continued.*)

* A paper read by Mr. Joseph Newton before the London Association of Foremen Engineers, November 4th, 1865.

STEAM AND CANVAS.—A New York paper speaks of the remarkable decline of sailing power and advance of steam power on the ocean as evinced by the fact that on one day twenty steamships left that port—two of them for Europe and eighteen for the Southern ports, to aid in the work of reconstruction. It is an evidence, also, of the way in which that country adapts itself to circumstances. Its sailing marine was becoming almost cumbersome. It had not dock and pier room enough to accommodate it: but as one steamship can do more carrying trade than a dozen sailing vessels, in consequence of the rapidity and regularity with which it traverses the ocean, the latter will gradually vanish, and the United States be able to do all the carrying trade they require with half the accommodation at the piers and docks.

SMELTING ZINC ORES.—The invention provisionally specified by Mr. A. Reynolds, of Bagillt, consists in the arrangement of a furnace (such as a blast-furnace) with a flue or condenser, in such a manner that zinc can be smelted in it instead of in retorts. The zinc passes off in vapour with the smoke at the top of the blast-furnace, and in order to retain the zinc in the metallic form air must be carefully excluded from the top of the furnace, or preferably coke must be placed in the flue, or charcoal may be employed instead; the coke will be heated by the smoke, or may be heated otherwise, so as to reduce the zinc to the metallic form. The zinc from the smoke is subsequently condensed in suitable chambers.

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BORING, DRILLING, &c.

(*Concluded from page* 91.)

Many works, from their weight or size, cannot be drilled in the lathe in its usual position, as it is scarce possible to support them against the drill, but such are readily pierced in the drilling machine, which may be looked upon as a lathe with a vertical mandril, with the flange of the poppet-head enlarged, with a table for the work, which is only occasionally fixed thereon. The structure of these machines admits of that endless diversity which is observable in manufactories, but probably no individual originated more useful varieties than did the late Mr. Richard Roberts, of the Atlas Works, Manchester. Figs. 1 and 2—Nasmyth's Portable Hand-drill—are simple examples of drilling machines. The spindle, as shown, is driven by a pair of bevel pinions—the one attached to the axis of the fly-wheel, the other to the drill shaft. Sometimes the drilling spindle revolves without end-long motion, and the table is raised by a treadle or by a hand lever; mostly, the drill shaft is cylindrical, and revolves in and slides through fixed cylindrical bearings. The drill spindle is then depressed, sometimes by a simple lever, at others by a treadle which either lowers the shaft only one sweep, or by a ratchet that brings it down by several small successive steps through a greater distance; and mostly a counterpoise weight returns the parts to their first position when the foot is removed. And so on.

Drilling machines of these kinds are generally used with ordinary drills, sometimes with pin drills; the latter appearing to be a type of the cutter bars used for larger holes, or holes of superior accuracy than can be got from the ordinary pointed drills. The small application of cutter bars is shown in fig. 3. The cutter *c* is placed in a mortice in a cylindrical boring bar, and is fixed by a wedge; this cutter extends equally on both sides, and the ears embrace both sides of the bar, which is slightly flattened near the mortices. Cutter bars of the same kind are sometimes employed with various forms of cutters, for grooves, mouldings, &c., and even screws on parts of heavy ordnance, and those which cannot readily be fixed in the lathe. Fig. 4 represents one of these, and the larger application of the principle as shown in fig. 5, where a cast iron cutter block is keyed on a cylindrical bar; the block has four or more grooves in the periphery. Sometimes the work is done with only one cutter, and, should the bar vibrate, the other grooves are filled up with pieces of wood to complete the bearing; occasionally cutters are placed in all the grooves, and carefully adjusted to act in succession—the first standing a little nearer to the axis than the second, and so on; but the last takes only a light finishing cut, to preserve its keen edge. It should be observed that in these cutters the one face is radial, the other differs only 4° or 5° from the right angle, and the corners of the tools are slightly rounded. The application of these cutter bars, though various, resolve themselves into three principal modes:—1st. It revolves without end-long motion in fixed centres, as a spindle in a lathe; the work is made to pass the cutter in a right line, and for this the work is often fixed to a traversing slide rest. The cutter bar revolves and also slides with end-long motion, the work being at rest. The bearings of the bar are then frequently attached temporarily to the work to be bored, and it may be mentioned that cylinders of forty inches diameter have been thus bored by attaching a cast iron cross to each end of the cylinder; the crosses are bored exactly to fit the boring bar, one of them carrying the driving gear, and the bar is thrust end-long by a screw with a ratchet wheel. Or, in another common arrangement, the boring bar is mounted in headstocks, and the cutter bar advanced by a screw. The screw is then moved either by hand, by a star or rachet wheel, or by a system of differential wheels in which the external screw has a wheel of 50 teeth, the internal one of 51 teeth, and a pair of equal pinions drives these screws continually, so that the advance of the 1-50th of a turn of the screw, or their difference, is equally divided over each revolution of the cutter bar. This second method only requires the interval between the fixed bearings of the cutter bar to be as much longer than the work as the length of the cutter block, but the bar must have more than twice the length of the work, and requires to slide through the supports.

This kind of cutter bar is likewise used in the lathe; whilst boring, the end of the bar slides piston-wise into the mandril. Such are applied to the larger kinds of vertical boring machines fitted with a differential apparatus to determine the progress of the cut; the bar then slides through a collar, which is fixed in the bed of the machine. In some of the large boring machines, horizontal slides are added, and, as will be understood, by their aid a series of holes may be bored; thus, the holes in the beams or side levers and cranks of steam engines are bored truly perpendicular in a line, and at any determined distances, by shifting the work beneath the revolving spindle upon the guideway. In other kinds of work the movement is lateral during the revolution of the cutters, for elongated countersinks and grooves

FIG. 1.

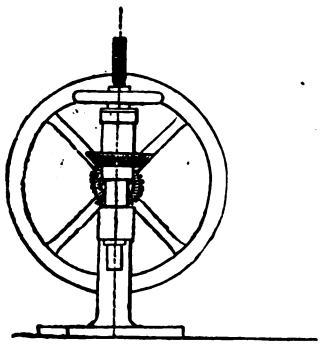


FIG. 2.

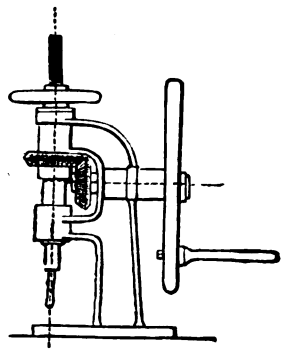


FIG. 6.

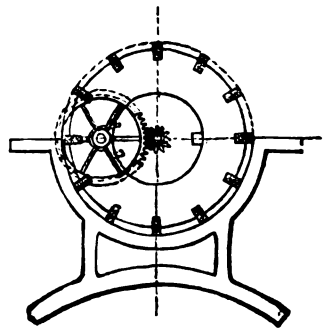


FIG. 3.

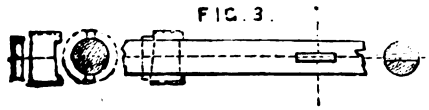


FIG. 5.

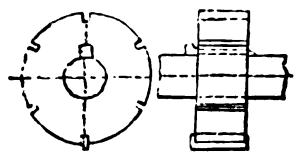
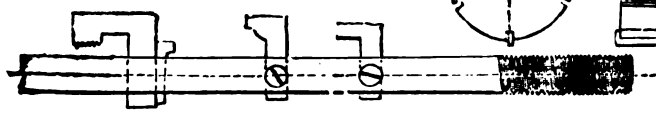


FIG. 4.



Lastly. The boring bar, in the largest application of the principle, revolves upon fixed bearings without traversing; and here it is necessary that the boring bar should exceed the length of the work by the thickness of the cutter block, which, by the way, traverses as a slide down a huge boring bar, whose diameter is above 30in.—that of the cutter block being sometimes ten feet. A groove and key couple them together, and the traverse of the block down the bar is caused by the side screw, on the end of which a wheel takes into a small pinion fixed to the pedestal of the machine. With each complete revolution of the cutter bar, this wheel is carried round the fixed pinion; and taking these to be 10 : 1, the wheel is moved a tenth of a turn, and, therefore, moves the screw a tenth of a turn also, and so slowly traverses the cutter block. In fact, this contrivance is a huge self-acting revolving sliding-rest, and the diagram, fig. 6, shows that the cutter bars are as well applicable to portions of circles, such as the D valves of steam engines, as also the interior of the cylinder itself.

Wood shavings are now extensively used for the manufacture of paper. To ascertain whether a given kind of paper contains wood it is dipped in a warm solution of aniline and pure sulphuric acid, when it will be immediately coloured orange if wood be present.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

STEAM BOILERS

Sir,—I am somewhat amused with the opinion and assertions of your correspondent A. Nelson on the subject of steam boilers. He don't appear to be in possession of a very extensive knowledge of the best modes of construction, or the action of heat and water upon the plates. If he will make a tube (welded) truly circular, and insert some welded pipes of a little less substance, in consequence of its smaller diameter, and weld those into his tube diagonally, vertically, or transversely, he will find this method an improvement upon staying by hoops of either angle or T-iron for the tubes will expand and contract equally, which is a great desideratum in the working of a boiler, not only so, but a preventitive to collapse, and a great saving in fuel in consequence of increased heating surface. If he is disposed to adopt this method of construction he will find there are some engineers who will no doubt applaud his efforts to improve the means of producing power with an increase of pressure at a decrease of danger, or risk. The process of welding boilers or tubes is simple, as also of welding one into the other, and if he or your correspondent Aspirant can take a journey to the Masbro' Boiler Works, I shall take pleasure in showing them how it is done.

Robert Jenkins.

Masbro Boiler Works, Rotherham, Nov. 23, 1865.

Sir,—In your last number you had an article on Drilling and Boring, than which there is probably no subject of greater interest to the mechanic.

In this article it is stated that, "As the cylinder bit is not intended to be used in drilling holes in the solid material, the following course should be adopted," &c. It is a misconception—a very popular one, I grant—to suppose that the cylinder bit is unsuited for drilling a hole out of the solid; so far from that being the case, it is the very best instrument that can be used for the purpose.

The recentering drills (your Fig. 6) is altogether useless, so also is the piercing drill (Fig. 5) after the cylinder bit is entered.

So great is my faith in this kind of drill that I would undertake with it alone to bore a 1-inch hole through a shaft 30 feet long.

Some time ago I had occasion to drill one hundred holes, through as many pieces of wrought-iron 8 inches long, 7 inches had a hole of ⅜ in diameter, the remaining 1 inch had a hole ¼ in diameter. drilled twenty of these in a day, of less than ten hours. I may remark that each piece was centered, and the ends turned in the lathe, one end was then held true by the chuck plate, the other revolved in a bearing; the holes were drilled by the cylinder bit, and when the end of the small bit came out at the end it forced out a very thin disc of the metal. In nine out of ten the centre mark upon which the iron was turned was exactly in the centre of this disc.

Probably many of your readers have done even better than this, so there is no doubt other of your readers besides myself would be interested in hearing of their practice, and I daresay you will afford them the necessary space in The English Mechanic.

W. H. Northcott.

Sir,—Doubtless you were not aware when you published in your paper of the 13th ultimo a method of generating steam power by gas heat that I was the patentee. As your notices and drawings may be calculated to lead parties to the belief that this method can be used otherwise than through my license, it is only right that I should inform you of the fact, and also inform you that either my manufacturing agent, Mr. Thos. Middleton, of 1, 2, and 3, Loman-street, Southwark, or myself will be happy to give you or any one interested all particulars and information on the subject.

I think it is only due to your readers and myself that you make this known through the same medium.

Arthur Jackson.

Patentee, 25, Delamere-crescent, Bayswater.
No. of Patent, 2047, 1860.

OVAL AND ECCENTRIC CHUCK.

Sir,—I was as much surprised as pleased by Mr. Muir's drawing and description of the above; for, a few years ago, having failed in an attempt to make a slide-rest, I adapted the materials to a similar purpose. The result is so exceedingly similar to Mr. Muir's chuck, with what I consider greater facility of change from oval to eccentric, and vice versa, and the whole at so moderate an expense, that I am

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tempted to send you a diagram. The cost to me was much under 10s., for I employed flat bar wrought iron, and rolled brass, so saving the expense and delay of patterns and castings. My own labour goes for nothing, and the proportion of wear and tear of tools for very little.

My chuck works satisfactorily, and I think that one similar, or better, is within the ability of any amateur turner.

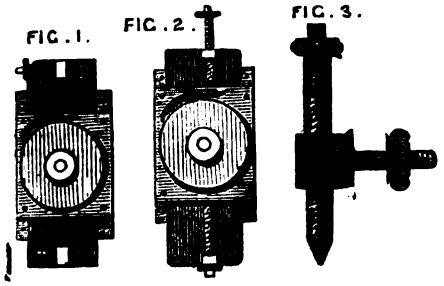


Fig. 1. Arrangement of chuck for oval turning. The screws are left on the slide for safe custody, and when placed as in the figure, allow the front plate to traverse freely along the slide. The fly nuts on the shanks of the screws allow of their ready removal from the slide, or of their adjustment at any angle.

Fig. 2 shows the front plate arranged for eccentric turning. The screws placed parallel to the slide adjust, and fix the front plate at any part of the slide as in ordinary eccentric chucks but more steadily; for, as the screws act against each other, there should be no shake.

Fig. 3 is an enlarged view of one of the adjusting screws. These can be placed nearer to the centre by means of drill holes in the iron slide.

CENCIKO.

OUR SUBSCRIBERS' NOTES AND QUERIES.

COIGNARD' s PUMPS.—Can any subscriber inform me where I can see one of Coignard's centrifugal pumps at work?—G. F. SUFFOLK.

CONDENSER.—Can any reader inform me how to make and connect a tinfoil condenser to an electro-magnet for giving shocks? Also state the price per square foot (not weight) of tinfoil, and where it is to be had, not being not being able to get it in Halifax, where I reside.—A. H. V.

CONDENSERS.—Any of your subscribers would favour me very much by informing me how the tinfoil condenser is fastened to the contact breaker—whether soldered or otherwise, or if it is fastened both to the upright with the pointed screw, and to the spring, and where the joint is made?—WM. GIBSON.

STEAM WHISTLE.—Will any of your numerous readers give a drawing of a steam whistle, such as used on locomotives, showing how the top part is attached to the lower cup giving the steam passage?—HENRY WILLIAMS.

DRAWINGS.—Can any of your readers inform me of the best method of making shaded and coloured drawings upon the patent tracing cloth.—A YOUNG DRAUGHTSMAN.

EXPANSION SLIDE.—Will any of your correspondents be good enough to inform me how I can determine the proper amount of travel for the expansion slide in Meyer's arrangement (when two blocks are used on a spindle having right and left-handed screws), also the position of eccentric in relation to the crank to cut off at any given point? I mean the eccentric of the expansion of the blocks, the position of the main eccentric being already determined.—EXPANSION.

WINDMILL.—I want to make a windmill to cut chaff, or pump water. Can any reader direct me how to construct one cheaply? A strong boy can do all that I should require of the mill.—GEO. B.

SHEET INDIA-RUBBER.—I wish to purchase a quantity of India-rubber in thin sheets. I have tried gutta-percha, but it did not suit my purpose. Can any of your readers tell me where to purchase the India-rubber?—C. C.

MAGNET.—Will any reader kindly inform me if there is any substance which, if placed between a magnet, and an object influenced by its attractive power, will destroy (either wholy or partially), the influence of the magnet on such object?—F. R. S. A.

BRONZE, ENAMELLING, &c.—Can any of your readers give me the following information:—

1st. Where I can get a book or other reliable information relating to the most improved method of the mixing and management of brass, bronze, and other alloyed metals. Or can you give a recipe for cheap machinery bearings, and brass for common purposes.

2nd. Can you supply me with a receipt for enamelling cast-iron on a cheaper method than is usually done. The common enamelling is excessively dear, and cannot be done nearer to Glasgow than London, which is a great drawback to its usefulness?—A FERRIER.

RUST ON GUNS.—Can any of your readers inform me how to preserve guns, revolvers, &c., from rusting without using oil or grease, thinking there might be a kind of varnish useful for that purpose, and where it is sold?—D. V. L. C.

COUPLING MOTIVE POWER.—I know a factory where they have two beam engines coupled. They are over-weighted. They are about to connect two oscillating engines to the same cranks. The steam first to the oscillating high pressure engines, and then to the condenser engines. I think if both had the steam direct, they would be of greater benefit. I shall be thankful if you or your correspondents will give me their opinion.—D. D. D.

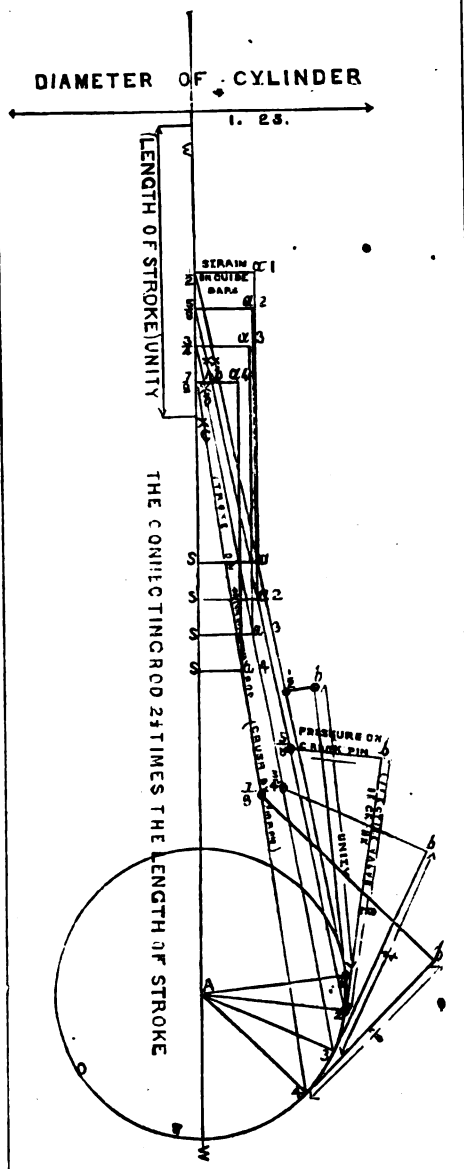
CRANK AND GUIDE BARS.—Will you permit me, through your valuable journal to ask some of your numerous correspondent two or three queries in relation to the crank and guide bars.

Enclosed is a diagram which I have made. I will first explain the construction, and then give my queries:—

W, W, is a vertical line passing through the centres of the cylinder and crank shaft; O is a circle, the diameter of which is equal to the stroke of the piston, and the circumference is the path of the crank pin.

The lines Xa, Xb, Xc, Xd, are the centre lines of the connecting rods at the different angles found at the corresponding part of the stroke as marked on the vertical line W, W.

The lines A (at the centre) to 1, 2, 3, 4, are the different centre lines leading through the crank and crank pin formed at the different portions of the stroke marked on W, W, and in connection with the connecting rod.



The lines 1—b, 2—b, 3-b. 4—b, are at right angles with the lines A. 1 2 3. 4 & 2. b is made the full length of the stroke 2—b⅛ less 3. b½ less 4 b ⅜ less, and so on. The lines ½—b ⅜—b ¾—b ⅞—b are at right angles to 1—b, 2—b, 3—b, and 4—b, and they are parallel with the lines A 1. 2. 3. and 4. and are made to intersect the connecting rod centres and b respectively.

Guide or Motion Bars.—The lines a1, a2, a3, and a4, are all the same length-that is, uniting each at their lower extremity intersect the connecting rod lines, each meeting the corresponding one at that particular portion of the stroke.

The lines S—a1, S—a2, S—a3, S—a4, are lines drawn at right angles to intersecting the lines a1, a2, a3, and a4.

I think I have made the above as intelligible as possible, and have no doubt that it will be readily understood. Now for the utility and the queries first. The crank first.

The lines 1—b, 2—b, 3—b, 4—b, are the effective valves of the crank. Does this relate to the length of stroke or the pressure on the piston? I understand it is thus:—Take the line 3—b, marked ¾, that is, ¾ of the stroke, therefore the pressure on the piston, multiplied by ¾ of the stroke is the effective value at that particular portion of the stroke, or portion of the crank pin path.

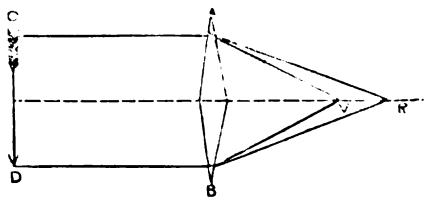
2nd. The lines ½—b, ⅜—b, ¾—b, ⅞—b, is the strain or pressure, or the crank pin to obtain the effective value of the crank. I understand it thus:—Take the line ¾—b, and suppose it to be ½ the length of the stroke, then the pressure on the piston, multiplied by ½ of the stroke is the pressure on the crank pin, which gives and acts as a lever to obtain the effective value ¾.

Query 3. To obtain the strain on the guide bars. The lines ½—a1 ⅜—a2 ¾ a3 ⅞—a4, represents the strain or pressure due to the angle of the connecting rod.

I understand it thus:—Suppose, for brevity, that the line ⅜—a2 equalled ½ the length of the stroke, the pressure on the piston multiplied by the length of stroke, and ½ of the product is the strain required.

I shall be very glad to receive any information on the subject that your correspondents can give.—WILLIAM COOPER.

TELESCOPES.—If your correspondent, E. B. P., has ever looked through a prism, or one of the triangular stalks of glass which hang from the old-fashioned "lustres," and seen the brilliant colours with which it fringes every object, he will easily understand why a telescope with a simple convex lens for an object glass will not bear any amount of magnifying power. A section of such a lens at right angles to its diameter, as at A B, in the figure, really represents two such prisms base to base. If C. D. be an object



illuminated by white light, a violet image of it will be formed at V, a red one at R, and intermediately, blue, green, yellow, and orange ones. Of course, at no distance from the lens will all these rays come to an exact focus, and this primary indistinctness when magnified to any extent becomes perfectly intolerable. In an achromatic telescope, on the other hand, where all colour is destroyed by the interposition of a second flint lens, reversing the order of the fringes, and where the image is virtually colourless, you may go on magnifying this image until it becomes obscure from loss of light, without materially impairing its sharpness. This explanation may also serve to show Athelstane why no telescope fit to look through can be made without an achromatic object glass. It is perfectly true that some few astronomical discoveries were made by the aid of simple lenses; but then, Athelstane must remember that some of them were of 120 feet focal length, were used without tubes in the most horribly awkward manner; and, moreover, that they cost a good deal more than four shillings (or even two pounds ten) to make. With regard to Magnifier's query: It will be much better for him to buy, either a reconnoiterer telescope of Salmon and Co., Princess-street, Edinburgh, (£10 10s., sent free), a "Dyer" telescope, sold by E. G. Wood, Cheapside, London, price, I think, 10s. 6d.; or even a second-hand instrument of Baker, of High Holborn, London, than to try to make one, (in which he will fail dismally) for 12s. 6d; Chance and Co., of Birmingham, are the only optical glass manufacturers.—A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

P.S. In the letter which you honoured me by inserting in No. 35, in line 21, the word printed "elliploid" should be "ellipsoid;" and in line 23, the words "best represents," should be followed by existing measurements.

ELECTRICITY.—In reply to your correspondent, Henry Gornell, in your No. 32. His plan for collecting electricity with 2 rolls of caoutchouc rolled up with 2 pieces of tinfoil, would not, I think, be found to answer. It must be proved that electricity dwells only on the surface of a conductor. Take a small tin cup, and fill it with brass chain, and fasten one end of it to a piece of silk thread, also connect a pair of pith balls with the cup. Place the whole on an insulated stand and charge it from a machine. The pith balls will diverge; now lift, by means of the silk, 10 or 12 inches of chain out of the cup, and the balls will then collapse, but will reopen when the chain is again lowered into the cup; proving that as the surface of the conductor is increased, so the electricity is diffused over it, and of course diminishing in power when more widely spread, therefore causing the balls to collapse; thus showing the fluid is not contained in the chain so long as it remains inside the cup, except at the top surface. Now, it having been proved that a large interior surface is quite useless as a conductor; it is easy to perceive that the inner rolls of your correspondent's arrangement would be needless, as they would, comparatively speaking, be without conducting power, and the outer roll only would be of service, thus the plan would reduce itself to an ordinary jar—a non-conductor covered inside and out with a conductor. The rolls of tinfoil and caoutchouc would, in fact, form a number of Leyden jars placed inside each other; with the interiors connected, also the exterior surfaces; in this plan the external jar only would contain the charge, the inner ones being useless. In an electric battery the jars are placed side by side to give more external surface; if they were put inside each other, no power beyond the outside jar would be gained, as above explained.—CYCLOPS.

TELESCOPES.—In reply to Athelstane, in No. 35 of your valuable journal. He can make an astronomical telescope to magnify about 36 times; for which the lenses will cost only three shillings and sixpence, or double that power, six shillings and sixpence.

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The answer to E. B P.'s query is that common lenses will not bear so high a magnifying power as achromatic lenses on account of distortion of the image by the common lens under high powers.

Magnifier A telescope does not magnify, but brings the object nearer to the eye and consequently it appears magnified.—R. B. WEGG.

LATHE.—In answer to J. W K., he may find this lathe suit his purpose. It is made as in fig. 1. On the end of the spindle there is a screw which goes into the mandrels, which hold the article to be turned. These mandrels screw up against the collar *b*, which is from 2 to 3 inches in diam.; *c* is the bobbin round which the cord passes from the wheel, the spindle ought to be about 19" long divided thus: the screw *y* 3" long, from *y* to the groove *x*, 7½" long, including screw, the bobbin *c* 3", and the pulley *f* 1". From *c* to the collar *b* 4", and the collar *b* ½" thick, the screw *a* to be 1" in length. The spindle is made so long, in order that it can slide backwards and forwards; this sliding motion is necessary for making screws and twisted columns.

When the spindle is wanted to stay in its place without sliding, a key (see fig 3) is placed at the left side, fig 1 *x*, this key is hung on a pivot so that when the spindle is to be kept from sliding, the end of it is lifted, and the round edge *a* (fig. 3) fits into the groove *x*, that is turned in the spindle. I have already said that the sliding motion back and front is for making screws of different inclination of threads. To make these kind of screws, there is a piece of wood fastened to the left end of the puppet, fig 1, *m*. In this piece of hard wood is placed an edge like a knife *n*, which enters into the thread of the screw; if the lathe be turned by a wheel, the pedal must be tied down, so as only to allow the wheel to swing partly round and then return. As all screws will not be wanted as that on the end of the spindle, screw on a piece of very hard wood on the end of the spindle, and grove it to the pitch of your intended twist, turn the nut *o* on after your wood is in its place,

FIG. 1

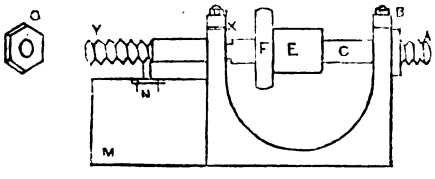


FIG. 3.

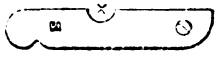


FIG. 2.

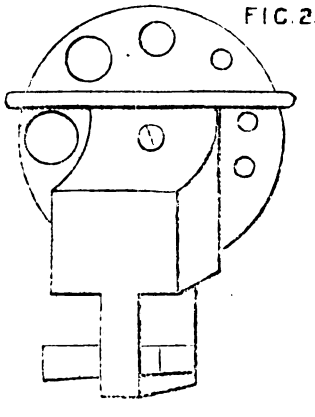
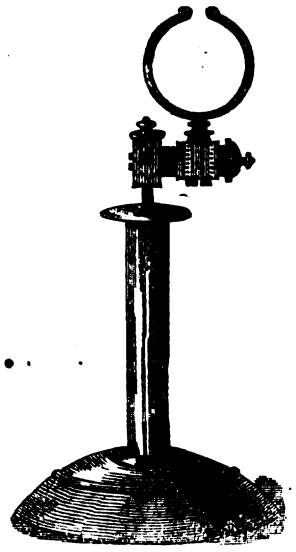


Fig. 2 is the right puppet, it consists of a block of wood with a disk screwed from the back, in the disc there is bored different sized holes to take the different sized columns, the disc revolves on its centre; the circle of holes to be the height of left puppet.—J. H.

INDIAN INK.—A Draughtsman can make a good Indian ink in the following manner:—Dissolve horn strip with caustic kali root till it is melted. The brown liquid you get is to be boiled in an iron kettle, until it is as thick as paste. Then pour on it boiling water (double its weight), and precipitate it with dissolved alum. Then dry it, grind it, mix it with gum water, and pour it in a mould. This is recommended by Mr. Boswen, a celebrated chemist.—PHILIP.

A CHEAP STAND FOR A 30 OR 36 INCH TELESCOPE.—Referring to Mr. Wegg's communication on cheap telescopes, I beg to give your readers the following hints, as regards making a stand for it. First I get a piece of beech wood turned to 9 inches diameter, and 3 inches deep, for a foot; next a pillar of brass or tin tube, (mine is a brass tube out of an old telescope) 9 inches long, and 1½ inch diameter, with a flange at the bottom, so that it can be screwed on to the beech with ordinary joiner's screws; then a double jointed gas fitting of the size made to receive a half-inch pipe, is soldered to the top of the pillar. Next I get a piece of tin 5 inches one way, and as much the other as will overlap (say ⅜ths of an inch) that part of the telescope in which the telescope would balance, the centre of which may be found near enough by poising it upon the fingers; loops must now be formed of the portion of tin overlapping, one at each end on one side, and one in the middle on the other, each loop to be ⅓rd of the length of the tin, and of a diameter to fit the insertion of a wire, which will, if the tin has been nicely fitted bind it to the telescope nice and tight. This cylinder is now to be soldered to the upright joint of the gas fitting, and the stand is complete; not perhaps so handsome, but quite as good as can be expected. I inclose you a sketch, which will perhaps help to illustrate my meaning.



Mr. Slugg's price is 16s.; other prices I know 25s, mine cost me 6s. I should be glad if some of your correspondents would communicate further upon astronomical instruments, such as equatorial movements, &c. Perhaps Mr. Slugg himself will favour us.—ASTRA.

BLANSHARD LATHE.—In reply to Nemo, No. 34, volumg II., the Blanshard lathe performs all he requires, cuttine shoe lasts, cricket-bats, gun-stocks, &c. He can see several working at the Enfield rifle manufactory, turning out many hundred rifle stocks weekly.—B. F.

FLY WHEELS &c.—In reply to J. D. E., I think Bourne's formula will give him what he requires, which is as follows: Multiply mean diameter of rim by revolutions per minute and square the product for a divisor. Divide the number of actual horse power of engine by number of strokes per minute, multiply the quotient by 2,760,000, and, divide the product by the divisor as above found. The quotient is the requisite quantity of cast iron in cubic feet to form the rim. With regard to the correctness of G. S's safety valve formula I beg to differ, the joint is the fulcrum of the lever, not the valve stem. It would be correct, supposing A to be length between weight and joint *b*, distance between valve stem and joint, and C, the weight, $\frac{a \times c}{b}$ would then give the correct weight on valve, the lifting pressure would be found by dividing the weight on valve; by the area of the valve in square inches. I take the liberty of correcting the error as it is a very usual one. The following is a table of Whitworth pitches to 1½ in.

Diam of screw	No. of threads to the inch.	Diam. of screw	No. of threads to the inch.
3-16	24	⅞	11
¼	20	¾	10
5-16	18	⅞	9
⅜	16	1 inch.	8
7-16	14	1⅛ & 1¼	7
½ & 9-16	12	1⅜ & 1½	6

Any further information in my power I shall be glad to furnish to Arrow, if the above is insufficient.—HESPERUS.

WHITWORTH'S SCREWS.—In compliance with the wish of Arrow, expressed in a recent No. of THE ENGLISH MECHANIC, I beg to submit you the following table of the number of threads to the inch for engineer's screws (Whitworth's).

Diam. of bolt or screw, &c.	No. of threads to the inch.
⅜ inch	16
7-16	14
½ & 9-16	12
⅝ & 11-16	11
¾ & 13-16	10
⅞ & 15-16	9
1 inch	8
*1⅛ & 1¼	7
1⅜ & 1½	6
1⅝ & 1¾	5
1⅞ & 2 in.	4½

HELIOS.

FLY WHEEL.—T. D E. wishes to know how to calculate the weight and diameter of fly wheels for engines of various sizes. I think the following will answer his purpose:—

H = horse power.
D = mean diameter in feet.
N = number of revolutions per minute.
P = total average pressure on piston in lbs.
W = weight of rim in cwts.

$$= \frac{P\,S}{45\,D}$$

$$\text{or} = \frac{13\,4\,4\,H}{D\,N}$$

D = stroke × 3½ or 4 generally. In corn mills the velocity of the periphery of the fly wheel must exceed the velocity of the periphery of the stones to prevent back wash. Sectional arc of rim in inches $= \frac{11{\cdot}42\ W}{D}$

Another method:—Diameter = 3 to 5 times stroke of engine. Weight of rim = about 3 cwt. per horse power.

$$\frac{\text{Weight in cwts} \times 11{\cdot}4}{\text{Mean diameter of rim in feet}} =$$

= Sectional area of rim in square inches.

$$W = \frac{P \times S \times a}{45\,D} \text{ where}$$

W = weight of rim in cwts.
D = diam of wheel in feet.
S = stroke in feet
A = area of cylinder in inches.

If a light wheel is required use 60 instead of 45. If a heavy one use 30. This rule gives to the fly-wheel 3 to 6 times the average momentum of the piston. I also send a table of Whitworth's screws for Arrow, from 3-16 to 6 in.

Diam. in inches.	No. of threads to inch.	Diam. in inches.	No. of threads to inch.
3-16	24	2	4½
¼	20	2¼	4
5-16	18	2½	4
⅜	16	2¾	3½
7-16	14	3	3½
½	12	3½	3¼
⅝	11	3½	3¼
¾	10	3¾	3
⅞	9	4	3
1 inch	8	4¼	2¾
1⅛	7	4½	2⅝
1¼	7	4¾	2⅝
1⅜	6	5	2½
1½	6	5¼	2½
1⅝	5	5½	2⅜
1¾	5	5¾	2¼
1⅞	4½	6	2¼

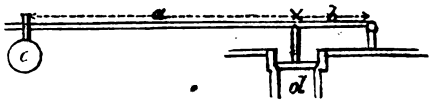
Excuse me for taking up so much of your valuable space.—JAMES MORRISON.

PRESSURE IN BOILERS.—In your impression of the 17th inst., G. S. appears to be incorrect. 1st. He does not take into consideration the action of the weight of the lever and weight of valve, both being part of pressure on d. 2nd, G. states $\frac{a \times c}{b}$ = total weight on d.

Let a = length between weight and valve spindle.
B = do. valve spindle and standard.
C = the weight in lbs.
E = action of weight of lever and weight of valve in lbs.
According to the principal of the safety valve lever:

$$b : a :: c : \frac{a \times c}{b}, \therefore \frac{a \times c}{b} = \text{resistance at standard.}$$

It is evident then, that $\frac{a \times c}{b} \times e$ = total weight on d, which gives the five following theorems for each quantity.



$$\frac{a \times c}{b} \times e = d \ldots (1)$$

$$\frac{d - c\,(a \times b)}{b} = e \ldots (2)$$

$$\frac{b\,(d - e)}{a \times b} = c \ldots (3)$$

$$\frac{b\,(d - c - e)}{c} = a \ldots (4)$$

$$\frac{c \times a}{d - c - e} = b \ldots (5)$$

J. S.

A COMMITTEE will shortly be appointed to experiment upon coal-cutting machines.

THE HEIGHT OF A SECTION OF THE GLOBE.—If it were possible to separate the globe at its centre, in the same way as an orange or cheese is frequently divided, and to stand at the base of the division, the chasm would represent a height 1,456 times higher than the Himalayas, or if Great Britain were reared on end from the Solent to Cape Wroth, it would reach but about one-twelfth of the distance.

*The scale is extended to 2 inches (a1, lib.)

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THE SOHO WORKS, BOLTON-LE-MOORS.

From the *Engineer*.

(Concluded from page 105.)

The greater number worked very well, but one or two out of the lot got each day out of order. The result was that the man usually employed to perambulate the works and lubricate the shafting, had to continue at least a supervision over the bearings, so that little or nothing was gained by the numerous lubricating apparatus. They were afterwards removed, with a return to the old system of hand lubrication, with its attendant objections, amongst others, of much waste of lubricating matter. The *sine quâ non* of an apparatus of the kind is thus simplicity, which seems to be attained in the plan. At the two ends of the brass, and at right angles to the axis of the shaft, are two recesses extending all round the journal. In the bottom half is the oil. In one of the recesses is a small ring, formed of round wire, sprung together with a tongue joint. We understand that a grooved bearing oiled in this way can be left to itself for more than a quarter of a year.

Thousands of men and boys are being every day let up and down the colliery pits of this country by means of wire ropes. It is only long habit that can quite overcome the rather uncomfortable feeling that one's life is literally dependent on a thread—of iron or steel though it be. In some mining countries, such as those of Germany and Austria, it is forbidden by law to use mining cages unprovided with safety apparatus for raising and lowering the miners. Much damage and loss of life are annually caused in this country from the mining cages being but seldom provided with one or other of the several forms of safety apparatus which have proved themselves to be more or less efficient. A rather large number of contrivances of the kind were to be seen at South Kensington in 1862; some of them very ingenious, and constructed on sound principles; others scarcely deserving such praise. We remember a very eccentric cage of the kind. It was so designed as to bring catches against the pit guides by means of the action of a common ball governor; and it was expected by the inventor that (supposing the instrument kept up its efficiency in the midst of the pit dirt and coal dust) a too high speed of the balls would be sufficient to cause the catchers to act and stop the descending cage. Unfortunately, however, the cage came to grief in the very Exhibition itself, as the governor balls refused to act when the cage (which was arranged in guides of some altitude) was allowed to drop by the exhibitor. An evidently much more efficient apparatus of the kind is that of Mr. Owen, made at these works, and several specimens of which have been in efficient action for some years in the Lancashire mining districts. The safety apparatus has also been applied to some of the hoists now getting so much into use in the great hotels and other establishments; and Messrs. Hick have set up one or two in the metropolis. The plan is simple enough, and bears on the face of it a stamp of satisfactory efficiency. The broad principle upon which the safety cage relies for its action when the rope breaks, may be said to consist in employing the weight of the tackle used to attach the rope to the cage to bring the safety catches into operation. Upon each side of the guide rods are two levers, turning on hinges upon forks fixed in the hoist or cage. The longer ends of the lever are jointed to connecting links, attached to a link to which is secured the winding rope. The whole weight of the cage is carried in the pins of the levers, the longer ends of which are also drawn up by the rope, while the shorter ends are also necessarily at the same time kept away from the guide rods. Should the rope break, the links and other parts also fall down, causing the short ends of the levers to catch against the guides, and this action is also quickened by means of springs placed in the long ends of the levers. These springs also in a great measure carry out the important functions of draw-springs between the rope and the cage, preventing those injurious jerks which quickly wear away the rope, more especially at the portion immediately adjacent to the cage. We hold that both safety and economy—generally convertible terms—should always lead to the addition of an elastic attachment between the cage and a wire rope—more especially in pits worked at a quick speed.

In the invention, as applied by Messrs. Hick and Son to a hoist for a mill or similar building, there are stops for the levers to sit against when hoisting; steel springs to force down the levers, and cause their sharp points to dig into the slide in case the rope breaks, a wrought iron cross connecting the levers to a pair on the opposite side of the cage. To the centre of this cross is attached the rope for lifting.

After having been making so many large stationary engines for such a number of years, being in the centre of the cotton districts, where, especially for driving machines for spinning fine numbers, very regularly working engines are so absolutely required, it was natural that the Bolton firm should direct all its skill to producing a better governor than the old centrifugal ball governor introduced by James Watt. Into the wide question of the best means of getting a regular number of turns out of an engine, it would not suit our present purpose to enter; but mechanics need scarcely be reminded that Watt's ball governor is defective in several respects. Many experiments have been made at the Bolton Soho Works with a view to introducing a better instrument, and the greater number of the mechanical schemes brought forward at different times have been successively tried. Some nine years ago, we remember that Siemens' isochronous governor was tried here, but apparently without lasting success. We examined a new form of engine governor now being made by Mr. Hick, and one of which is very successfully regulating the large engine which drives the tool and turning shops. It has been patented by Mr. Standfield, and though its general principle is scarcely novel, it doubtless embodies patentable practical details. The inventor also proposes to employ it for a marine engine governor, great numbers of which are now in demand, as the necessity for and advantages of attaching a governor to a marine engine are now generally understood by shipowners. Its general principle—which, as we have said, it has been more than once previously attempted to practically apply—consists in employing the resistance afforded to the motion of a fan or disc in a liquid, or even fluid, enclosed in a case. The liquid may evidently be also revolved in the case against the blades. At a certain determinate speed this resistance is, of course, constant, and a variation may, by easy means, be at once brought to act on the throttle valve. An advantage is doubtless the easy means of setting the instrument by moving the weight up a graduated lever.

ON A MEANS OF INCREASING THE RESISTANCE TO RUPTURE OF HYDROSTATIC CYLINDERS.*

By St. JOHN V. DAY, C.E.

Hitherto it has been generally assumed that the immediate cause of rupture in hydrostatic cylinders is the pressure of the fluid against their internal walls. Primarily, this is the fact, but by careful observations upon the structure of cast-iron, of which material these cylinders are usually, if not always, made it has been asserted, that although the cause of rupture has its origin with the concentration of external force within the cylinder walls, yet there is reason, as will hereafter be seen, to believe that, carried to the extent it is usual to employ in practice, this of itself is not sufficient to produce complete disruption of the mass.

It has long been known that cast-iron, when cooled in large masses (such as hydrostatic cylinders, guns, &c.), has always its portions towards the centre of a density much inferior to that at and approaching to its outward surface; and although this inferiority may be much reduced by running the metal into the mould, and allowing it to cool under the pressure of a static head of fluid metal, as proposed and experimented upon by Mr. Mallet, in 1840,† still it must ever remain an impossibility to bring up the tenacity of the interior portions of a heavy cylinder equivalent to those further from its centre. The laws of cooling themselves, at least render it impossible, however much the ingenuity of mechanicians may, by the introduction of abnormal circumstances, modify them so that the permanent irregularities of stress may be diminished.

This acknowledged deterioration of the tensile value of cast-iron under the conditions above mentioned, has led to a large amount of investigation, both theoretically and experimentally, on the part of the ablest mathematicians and mechanicians, amongst whom, under the first head, may be mentioned, Barlow, Lame, Rankine, and Hart; under the second, Mallet, Longridge, and others. By the first named of the class a formula has been proposed, and which has been modified by the others, tending towards an accurate expression for the tenacity of any given cylinder of cast-iron; in all probability, that of Professor Rankine approximates most closely to the truth.‡ Various values for the reduction of strength in large castings have been given by those whom we have mentioned under the second head, viz., Mr. Longridge stated, "he felt confident that in a mass of metal, such as that required for a 68-pounder gun, the loss of strength would be at least fifty per cent."* The same author further on remarks:—"When that was combined with the loss of strength due to a homogeneous cylinder, it easily explained the bursting of hydraulic presses."†

This initial drawback to the employment of iron in thick castings, has induced engineers at different periods to suggest, and in many instances adopt, means for artificially strengthening them, which, in the case of hydrostatic cylinders and ordnance, has been effected in some instances by shrinking on their exterior tubes or hoops of malleable iron, or in others by enveloping them in a series of coils of wire. But, whatever the objections may be to manufacturing cylinders in this manner, one thing is certain, that for hydrostatic presses it has but in a few instances been resorted to.

Referring again to Mr. Longridge's paper, we find it there stated, in reference to a hydrostatic press cylinder of ten inches diameter, that using the "formulæ of Lame, afterwards deduced by Dr. Hart, in his calculations for Mr. Mallet, and by Mr. C. H. Brooks for the author, also arrived at by Professor Rankine by another method, the bursting strength would be 3½ tons per square inch.‡"

It will not be denied that up to the present time it has been impossible to obtain ordinary cast-iron cylinders of large size to resist a pressure of three or four tons per square inch—the aggregate of cylinders annually ruptured at a lower pressure fully bear out this conclusion.

The author's attention has recently been drawn to the consideration of certain observations which have been carried on for some time by Messrs. Weems, engineers, of Johnstone, near Glasgow, relative to the rupturing action of water as it obtains ingress to the intermolecular spaces of hydrostatic cylinders. It is held by these gentlemen, that the entrance of the water into the substance of the cylinder is in effect equivalent to slicing off a ring of the metal either inside or outside, thereby proportionately reducing its resistance to internal fluid pressure. The action of the water may be referred to an annular series of wedges inserted in every possible crevice in the cylinder's walls, and driven in to rend the cylinder, so that, as each wedge penetrates the substance, the tenacity of the substance is proportionately reduced; similarly, the greater the pressure, the consequently greater distance will the water obtain vent into the cylinder's substance, when rupture is very easily brought about, the extent of entrance of the liquid also depending, under any given pressure, upon some function of the density of the iron as the exterior surface is reached.

Putting x to represent the distance that the water would enter the cylinder's substance under any given pressure, d the density of the material, and ϕ the function of increased density as the cylinder's exterior limit is reached, then—

$$x \propto \phi\,(d).$$

It is a fact, that under moderate pressures water always does find its way completely through so porous a substance as cast-iron, and distributes itself over the surface, at first in the form of very fine particles, which by-and-bye aggregate, and may be seen to run like rain-drops, in lines extending downwards. Taking it then for granted (as the firm before referred to have done) that this interstitial entrance of the fluid diminishes the tenacity of the material, it was next sought to obstruct the passage of water, and from the results that have been and are being obtained, a doubt cannot remain that this difficulty has been speedily and successfully overcome, and that ordinary hydrostatic cylinders may thereby be rendered considerably stronger within their usual working limits. The remedy for this evil consists in placing a very thin lining of a material having great density, and consequent high impermeability, between the liquid and the cylinder—that is, a thin cylinder fitting closely to the bored interior of the ordinary cylinder. The material used for this purpose so far has been copper.

We now have to show whether any truth existed in the previous considerations relative to the supposed injurious influence of the intermolecular entrance of liquid. If the tested cylinders had burst at the same pressure that unlined cylinders had previously done, it is clear that the expense and trouble

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* Extracted from the *Practical Mechanic's Journal*.

† Trans. British Association. pp. 304 and 305; Construction of Ordnance. Arts. liv., lv., lvi., and lvii.

‡ Applied Mechanics, Art. 273.

* Transactions of the Institution of Civil Engineers, vol. xix., Session, 1859-60.

† Transactions of the Institution of Civil Engineers, vol. xix., Session, 1859-60.

‡ Ibid.

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of lining would have been worse than useless; but this is not the case. Hitherto an ordinary hydrostatic cylinder, unless strengthened externally, having a ram of 24 inches diameter, could not be relied upon at a pressure much above two tons per square inch—certainly not above 2 5 tons. A cylinder of this diameter, bored out and lined as we have previously explained, has been for a long time, and now is, working at a constant stress of 3·5 tons, for the manufacture of metallic pipes; and Messrs. Weems believe this press to be perfectly safe at this strain for any reasonable length of time. Until the introduction of the copper lining they found it impossible to obtain cylinders sufficiently strong to resist the pressure necessary for the manufacture of metallic pipes. The same firm have a 33-inch cylinder, also used in the manufacture of metallic pipes, and constructed in the same manner—but we do not know what they consider to be the safe working limit in this instance. That the theory here broached is no myth, is evident from the number of presses that are being constructed on the system in and around Glasgow.

The view set forth is one that for a time may meet with opposition, and it may yet receive another explanation, having reference to a chemical rather than a mechanical cause, probably the exact truth lies in a combination of both. It is generally known amongst engineers, that if the natural surface is removed from a piece of cast-iron, and that in this state it is exposed to atmospheric influences, or is placed so that steam or mist becomes condensed on the exposed surface, in a short time oxidation will have taken place to some distance below the surface, and the tenacity of the iron becomes diminished in a ratio depending upon the difference of strength of corresponding sections of unoxidated and oxidated portions; in a given specimen the tenacity will vary as a function of the depth to which the oxygen has reached. It is almost certain that after a withdrawal of interior fluid pressure, the elasticity of the cylinder acting on the intermolecularly held particles of water causes them, or a greater portion of them, to be extruded, and thus a large portion of the space they occupied is left partly empty, at that time, in all probability, the oxygen attacks the tiny pillars by which each interstice may easily be conceived to be surrounded. As this action goes on, so the tenacity of the cylinder is rapidly reduced, and, as hitherto, breakdown after breakdown has been a continual annoyance and endless expense.

ON BEARINGS.*

Of all the materials now employed in bearings, none have given such remarkable results as hard wood. It would seem, indeed, as though there were peculiarities about its texture which render it next to impossible for iron—or metal of any kind, indeed—to abrade it, no matter how excessive the pressure, so long as it is kept cool. Brass will cut although a stream of water flows over it, and in the early days of screw propulsion the end of a shaft has before now been literally welded to the iron plate provided to take the end thrust, under a sheet of water intended to keep it cool. John Penn, we believe, first proposed the use of lignum vitæ strips as a lining for the bushes of screw shafts in the dead wood. Before fitting them on board ship he tried many experiments with very singular results. Under pressures as low as 200 lb. per inch iron cuts into bearings; with pressures of 6 cwt. iron cuts into iron, no matter what the lubricant; and with pressures of about 10 tons, surfaces of the hardest steel which can be produced rapidly abrade each other; but bearings made of strips of lignum vitæ, inserted in dovetail grooves cut in an ordinary brass have borne 8,000 lb. per square inch without showing the slightest symptom of wear. With pressures of nearly 2 tons to the inch slight scratches originally existing in the wood were not cut out after the shaft had run for hours. But one condition is necessary to the complete success of hard wood bearings, and that is simply that they should be kept cool. Neither oil nor grease seem to suit them, but under water they will wear almost for ever. Thus a stern bush lined with lignum vitæ strips, fitted on board the Himalaya, after the ship had steamed 20,000 miles, remained as perfect as the day it was put in, not the slightest trace of wear being perceptible. Part of the stern bush of the unfortunate Royal Charter, wrecked on the Welsh coast, is preserved in the Patent Museum, South Kensington. It was fitted up with lignum vitæ strips, which are as good as the day they were fitted. In practice it appears that the iron and wood are in direct contact, the water merely acts as a conductor to convey away the heat generated, particularly under heavy pressures, the difference between the character of surface of the two materials apparently precluding all interlocking of particles. Water is not a good lubricant, squeezing out under very moderate pressures; but it acts very much more efficiently in conveying away heat than either oil or grease. No lubricant can discharge its office properly unless it possess such a capacity for caloric that it can absorb and remove, either by its evaporation or otherwise, the heat which is invariably generated in greater or less degree by every form of friction. Grease acts almost altogether by reducing friction. Oil, both by reducing friction and carrying away heat, and water almost altogether by preventing any considerable rise of temperature; and, therefore, as a general rule, oil is the best lubricant. In the case of wood bearings, however, it is neither necessary nor advisable to keep the surfaces out of absolute contact. The wood, so to speak, acting itself the part usually taken by grease or oil, it only remains that the heat generated should be carried away, and this the water flowing along the shaft between the strips and leaking into the screw alley, does effectually.

We have said that under loads of 10 tons per inch the hardest steel cuts into each other, but under moderate pressures their wear is infinitesimal, and the frictional resistance very moderate in amount. Yet in practice large steel journals working in steel bushes have given very indifferent results. They have been tried in the case of the crank pins and coupling rod ends of locomotives more than once, but at present their use is almost, if not altogether, confined to such mechanism as the link motion of locomotive and stationary engines. The great obstacle lies in the difficulty of rendering a large steel surface equally hard all over, and of preventing distortion in the bush during the process of tempering. If a hard spot exists in the journal it is certain to cut into the bearing, and *vice versa*. It is to be remembered, however, that but for steel wearing surfaces, locomotive valve gear would certainly never have possessed the finish or worked with the efficiency and durability it actually manifests, and manufacturers of the smaller classes of steam machinery might probably find it worth their while to extend the application of steel bushes even to connecting-rod ends and crank shaft bearings.

* Extracted from the *Engineer*.

GENERAL NOTES.

SELF-ACTING BRAKE.—Reference was made a few weeks since in the letter of one of our local correspondents to an improved self-acting brake intended for use on common roads, invented by Mr. R. B. Mitchell, of Sheffield. It appears that in ordinary practical use the brake proves quite as efficient and valuable as was anticipated from the experimental trials. By a simple and ingenious connection with the shafts of the vehicle to which it is applied, the brake is lifted from the wheels in ascending a hill, and in the ordinary forward motion of the carriage, but upon a down-hill movement being commenced the brake is instantaneously applied, and increases in power as the steepness of the descent increases.

USE OF GLYCERINE FOR MOISTENING MODELLING CLAY.—The last number of "Cosmos" records some experiments on the use of glycerine instead of water for moistening modelling clay. Clay first well dried and then rendered plastic by admixture with glycerine was kept in a hot room for two months, at the end of which time its plasticity had not in the least diminished. Clay rendered plastic by glycerine would seem to be capable of being used over and over again indefinitely, just like wax, with the advantage over wax of always retaining the same consistence and degree of plasticity, neither being hardened by cold nor softened by heat.

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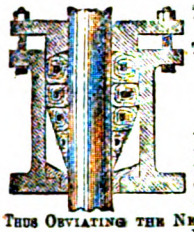

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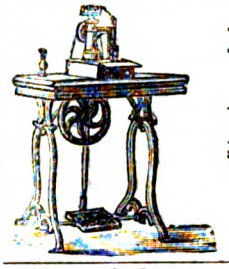

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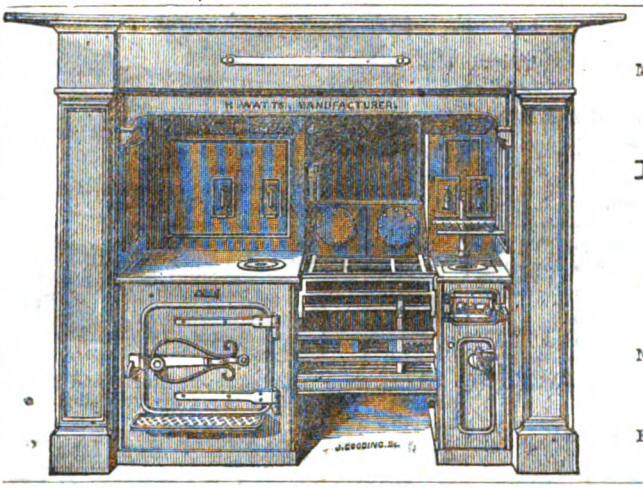

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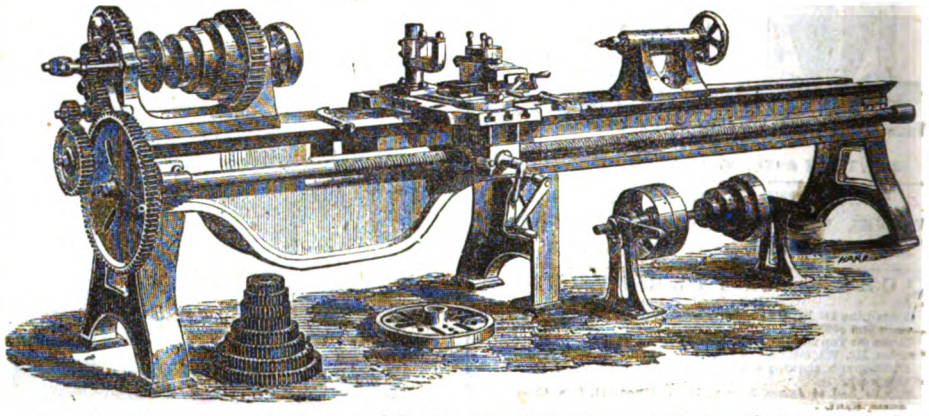

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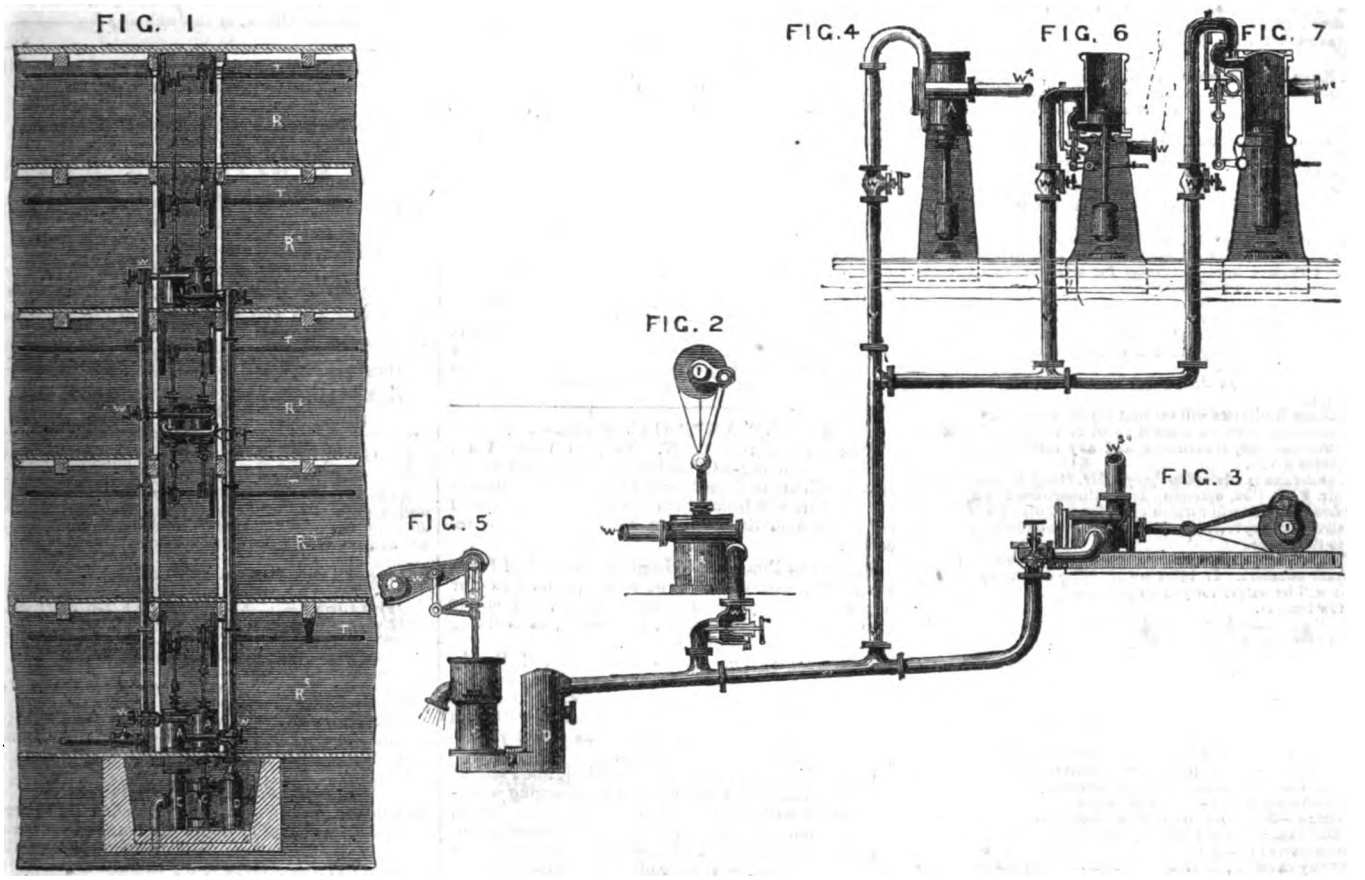
THE

ENGLISH MECHANIC:

A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

Vol. II.—No. 37.] FRIDAY, DECEMBER 8, 1865. [Price One Penny.



CROSSLAND'S IMPROVEMENTS IN STEAM ENGINES FOR BLOWING, PUMPING, &c.

Letters patent have been granted to Mr. James Crossland, of Ashton-under Lyne, for improvements in steam engines for blowing, pumping, or forcing air, pumping water, driving machinery, &c., and in the construction of the houses or beds of steam engines. One part of these improvements we this week illustrate. The first part of the invention relates to blast engines for pumping or forcing air, and its object is to form a direct acting steam condensing blast engine, dispensing with the beam hitherto used with condensing engines, and consists in a combination and arrangement of a steam cylinder, blast cylinder, and air pump cylinder for the condenser, so that the pistons are all connected to the same piston-rod or a continuation of the piston-rod of the steam cylinder, &c. The second part of the improvement relates to direct acting condensing steam pumping engines, and consists in combinations and arrangements of such engines as are described under the first division of the specification. The third division applies more particularly where a number of independent steam engines are required, such as steam hammers, rivetting machines, blowing engines, and other ordinary otherwise high-pressure engines; and these may be situate in various places, and in different rooms; and this part of the invention consists in arranging so that each steam hammer, &c., will discharge its exhaust steam into a main pipe leading to a common or general condenser. In applying this part of the invention to steam hammers the patentee forms a vacuum with an air pump and condenser or main pipe and piping, with or without a jet of water in the said condenser, into which the steam is discharged from the hammer. The using vacuum with steam hammers is applicable to all forms, but the patentee states that his improvements give rise to new features and modes of using and applying the said vacuum so obtained by an air pump as described, and these are as follow:—Using the steam with the vacuum acting on the top and bottom side of the piston of a steam hammer, namely, as used double acting; or when the steam with vacuum is used single acting, namely, only on the bottom side of the piston of the steam hammer, as shown in Fig. 6, with or without the atmosphere acting on the upper side of the piston, with open-end cylinder, being an atmospheric steam engine; or the cylinder may have a closed tap, in this case a compression of air will take place; or the steam hammer may be made on the single acting system, with atmospheric pressure acting upon the under side of the piston, as shown in Fig. 7, having steam and vacuum applied to the upper side of the piston, which is regulated by the working slide or other valve J, and its working gear and handles J^1; when not required to be at work, the vacuum communication is shut off from the steam hammer by the stop-cock or valve w^1, and in like manner the steam communication by the stop-cock or valve w^2. Figs. 1 to 7, inclusive, represent otherwise high pressure steam engines, steam hammers, blowing engines, and rivetting machines, being or required to be situate in various places or rooms in manufactories, as shown in Fig. 1, which is a section of a manufactory with five storeys R^1, R^2, R^3, R^4, R^5, having steam engines A, A, A, driving as many lines of shafting, T, T, T, as may be necessary, arranged in any convenient manner, and by means of these arrangements, as described, transverse and upright shafts, and wheels for speeding and transmitting powers are dispensed with. Each of the otherwise high pressure engines is so arranged that its exhaust steam is discharged into a main pipe w, leading to a common or general condenser, D^1, in connection with an air pump C^1, and which said exhaust steam would in non-condensers have been exhausted into the open air, or otherwise. A general or common vacuum is made by an air pump or condensation of steam available for land or stationary engines. If the main piping W, W, is extensive in its length and disposition it will necessarily act in a great measure as a surface condenser, and may be placed as much exposed to the action of cold air or of water as may be found convenient; by this means a very little jet of water will be required to complete the vacuum made permanent by the air pump. The air pump C^1 is worked by a special steam engine for that purpose, or an air pump and condenser already in use

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for other purposes may be made use of, thus facilitating the adoption and use of the patentee's invention of changing non-condensing engines into condensing, and securing the additional power and economy. A stop-cock or stop-valve is used to close the communication between the steam engine and the air pump and condenser, and this stop-cock or valve may have two ways, which when closed to the air pump may open to the atmosphere; this stop-cock or valve W_1 closes the air pump connection, whilst that at W_2 closes the boiler connection for steam.

ANSWERS TO CORRESPONDENTS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

E. KEET.—The firms are so numerous that it will be best for you to advertise in one of the daily papers.

J. K.—Send the letter to us at 75, Fleet street, and Mr. Taylor will receive it.

T. W. D.—Can obtain the information of any practical man. Two or three answers to Henry Williams already forwarded.

HENRY SPICER.—Search back numbers, the question has been answered. If still in doubt write again.

WILLIAM WILLIAMSON.—Received.

D. V. F. C.—Mr. Menz, Revensbourne-street, Greenwich.

AN AMATEUR MECHANIC.—The first would be costly to make, and require many diagrams for explanation. For the second, search back numbers.

J. LEDDON.—Why not have returned the engine, if it did not suit you. Explain yourself more clearly.

H. BUDD.—See the "Boy's Play Book of Science," or you can purchase one ready made at a less cost than you can procure the chemicals

ROBERT THOMPSON will receive an answer per post in a few days.

WILLIAM WILLIAMS will see that his letter was forestalled.

TORRICELLI is recommended to write to Mr. Slugg 214, Stretford-road, Manchester, and any information will be gladly given.

ATHELSTANE is advised to apply to Mr. Slugg, as above, or to Mr. F. J. Cox, optician, 23, Skinner-street, Snow-hill, London, who will furnish price list and directions to construct a cheap telescope for 3 stamps. Magnifier is referred to the above.

W. B.—The letter has been answered too often; search back numbers. If thinking of going into the business, it will be safest for you to pay some practical man for a few lessons.

R. GURNELL.—Any artists' colourman will explain the matter to you; we cannot spare space.

BREAM DOWN.—Good.

KEHOE BROS.—Virtue, Publisher, Amen Corner, Paternoster-row, London, will supply you with the whole series. T. Jackson will most likely do so.

NUIKE.—Received after other communications.

YOUNG PLUMBER.—We cannot undertake to guide you; our space is valuable, and the necessary engravings would be costly. Try Spon, publisher, Bucklersbury; or Virtue, Amen Corner, and procure the necessary works.

T. J.—Steam pressure. No inclosure.

WASHER.—Send to T. Dunbar, 4, Lewes-road, Brighton.

T. DUNBAR.—Forward the drawing to us. The plates can be obtained of any small type founder. The ink purchased of any chemist; it is useless to make it in small quantities.

SILEX.—Of most mathematical instrument makers, price from 4s. upwards.

A. O. Y.—See lists in Post-office London Directory.

AN OLD CLERK.—Next week.

G. H. DUNMAN.—Thanks for your courtesy; we may perhaps treat on the subject again.

CUNA.—Will see that the subject has already been treated upon. Try the treatise of W. Binns, published by Spon, Bucklersbury.

W. AUSTIN, C.E.—Thanks for communication, but cannot spare space.

J. H.M.—The idea is good; write and explain your views more fully.

N. J. W.—Next week.

LEDINGHAM.—Cannot spare space at present.

JOHN YEADON, in answer to J. Y. D.—No sketch enclosed.

S. WATSON.—Why not ask one of the experienced draughtsman in your office?

DUBLIN.—See list in Post-office London Directory.

H. Q. P. Z.—Only by hunting about wharfs and timber yards. The price according to the article. Why not advertise?

BLAIR, Manchester.—We do not know of one at present, but an advertisement in a daily paper would bring in any answers.

R. J. ATCHERLEY.—If of simple make, the instrument would be very useful. If you cannot afford a patent, you may get some manufacturer to take it up. If you send the drawing and letter-press to us we may perhaps illustrate it.

J. L. G.—Apply to Mr. Spence, Quality-court, Fleet-street.

JAMES LITTLE.—The drawings, you perceive, have not been lost sight of.

JOHN B WILLIAMS.—The particulars have already been entered into as closely as we can spare space for.

JIM.—Wheeler's make would suit you.

MAGNETISM.—Next week.

W. H. C.—Of any manufacturing chemist. Your second communication appears in another column.

J. J., Junior.—Received, but forestalled by another contribution.

A NOVICE.—Of any respectable stationer.

GLOUCESTER ENGINE DRIVER.—Mr. N P. Burgh's work is sound and practical, and will be of great use to you. It is published by Spon, of Bucklersbury.

R. F. W.—WATERPROOFING. In a previous number we informed you that articles had already appeared on the subject. Thanks for the trouble you have taken.

JOHN HATTERS.—The matter is so very simple that you had better ask the advice of some experienced journeyman.

J. O. S.—MARKET PRICES. In making fresh arrangements for the new year, we will bear your suggestion in mind. We are glad that the article was of use to you.

AN ASPIRANT.—A sound education followed by close study of all appertaining to naval matters. Above all a real love of the profession.

H. J. ILIFFE.—Try again.

E. FARNWORTH.—Received, but previously answered by another.

T. K.—Some instructions have been published in our first volume. The stains and directions are sold by most respectable oil and colour dealers. See Post-office London Directory.

T. VALENTINE.—Received.

A. FLEMING.—Will endeavour to forward.

HENRY NORTON.—You can purchase one complete for half the price the wheels will cost you. Try the *Horological Journal*, 61, St. John's-square. We really cannot spare the space.

T. A. W. G.—Search back numbers.

INQUIRING GEORGE.—If your lamp is properly fixed, you can use nothing better.

HORACE.—A liberal education, knowledge of mathematics, skill as a draughtsman, and study and practice while young, in an office where plenty of business is transacted.

Several letters remain over till next week for answer.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

RECENT AMERICAN PATENTS.

ORE CRUSHERS.—A. W. Hall, of New York, claims a stamping-mill having an air-tight battery, into which air is forced or drawn through one or more inlets, and from which the pulverised material is carried with the escaping air to a suitable receiver.

PUDDLING FURNACE.—Hugh M'Dondald, of Pittsburgh, Pa., claims the use of iron ore in its raw or unmelted state, previously ground fine, and mixed into thick paste or dough with water, as a fixing for puddling or boiling furnaces.

IRON AND STEEL.—James Henderson, of Brooklyn, N.Y., claims mixing manganese, or the equivalent thereof, with the ore or ores charged in the blast-furnace for smelting, in combination with and to produce crude molten iron, to be directly converted by the pneumatic process.

CARBURETTING AIR.—Erasmus Allington Pond, of Rutland, Vt., claims the method of charging atmospheric air with the vapour of hydro-carbon fluids, by the discharging the air through contracted openings into the mass of fluids; also, of charging atmospheric air with the vapour of hydro-carbon fluids, by dividing the column of air, and discharging the same into the liquid in small streams.

INCRUSTATION OF STEAM-BOILERS.—A. F. Porter, Philadelphia, claims the apparatus consisting of a conductor armed at one end with a series of points, or their equivalents, and connected at the other extremity with the shell of the boiler, the whole being constructed within it at some intermediate point by an insulated attachment.

CUPOLA FURNACES.—Annes A. Lincoln, of Norton, Mass., claims the arrangement of the steam-jet and air or blast apparatus, so as to cause the commingled currents of vapour and air to enter the furnace at a point above the grate or fuel base without first going through it, meaning specially to claim a cupola furnace as made with tuyeres and steam-jets combined together and arranged with respect to its hearth.

ROLLING IRON AND STEEL.—D. Hall, Pittsburgh, claims the use in one set of housing of two pairs of rolls arranged with their axles all in the same vertical plane, the upper pair being geared together so as to pass the iron or steel through between them in one direction, and the lower pair being geared together, so as to pass the iron or steel through between them in the opposite direction, for the purpose of enabling a continuous strip or band of metal to be passed backwards and forwards between the rolls, and thus operated upon at several points at the same time, and for other purposes; also the combination of the guide roller, and adjustable guide, and curved guide box, with one or more pairs of rolls.

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OUR CHRISTMAS NUMBER.

IN announcing his intention to publish an enlarged Edition of THE ENGLISH MECHANIC as a Christmas Number, without any increase in price, the Proprietor respectfully submits that he thereby affords the many thousands of readers and numerous contributors, an opportunity of each contributing a something as a Christmas Treat for his fellows—some little "trick of trade" (in the good and true sense of the word); some improvement in tools, anything, in fact, which may be of value to brother workmen, and will assist in the promotion of feelings of kindliness and good fellowship, which the season is so eminently calculated to call forth. The Editor will not fail on his part, and will be glad to find a hearty response to this challenge to do mutual good.

The English Mechanic.

FRIDAY, DECEMBER 8TH, 1865.

THE "MECHANICS' EXCHANGE."

WE do not mean a grand building in the Italian or any other style, in which journeymen, their employers, and amateurs may congregate and exchange opinions on matters, but what may in the end prove of far greater value, and which we will now proceed to explain. At times we have had requests sent to us for sketches and plans, which in the nature of things it was simply impossible for us to comply with; sketches and letters have been sent to us to be forwarded to contributors, and this we have willingly done and continue to do, knowing how beneficial such an exchange is in general, both

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in rubbing down angularities in opinions and furbishing up those which were sinking into "remains" for want of proper expression. In no single thing has this proven of more benefit than in connection with the lathe; and this has been well evidenced to us in many a letter of thanks. That this system should be extended appears a generally felt wish on the part of our subscribers; and, therefore, we propose to open for their benefit an "Exchange." Respecting the lathe, we advise "an interchange of sketches, impressions on rice paper, or better than all, stereo-photographs of specimens in turnery. In nearly all the works on this subject, the plates are, with few exceptions, confined to plain surface ornamenting, while such subjects as, say necessaries for ladies' work-tables, paper weights, ring and watch-stands, bouquet-holders, trays, cups, vases, counters, chessmen, &c., or composite works of a more elaborate nature of architectural design, capable of being finished on the lathe, with or without revolving cutters, are not at all represented." This is the opinion of many who consider themselves enthusiasts, but whom we consider simply sensible amateurs. Again, in electricity and its reduction to a workable motive power there are many ideas afloat among our readers—exchanges could be made of tracings here. In various labour-saving appliances connected with and apart from all descriptions of lathes; much could be done in casting, soldering, bronzing, tinning, pattern-cutting, templates in general, aye and ten thousand other things, for there are always ideas extant which reduced to tracing paper, exchanged, and recorded, will cause others to think and ponder upon, and, perhaps to mature; and thus the rough notion of an inventive mind benefits the community at large.

One advantage of our scheme is this: A person turns off one pattern at the lathe, he desires others, with rough notes of the "how" to do it; he sends us half-a-dozen, each signed with his name and address, and stamps, and says what he would like in exchange; in turn, we insert a notice to this effect:—

"Sketch: Product of geometric chuck combined with rose engine. In exchange for do., oval chuck with do."—

Or whatever the thing may be. The notice will produce its answers, which will be forwarded at once to their destination. And so on with everything else. And thus it will happen that, in the case of the workers at the lathe, each may in time become possessed of an excellent collection of examples and notes, making up a volume of reference, the value of which to them it will be impossible to estimate.

We are ready to take this in hand at once, and we have little fear of the result.

Furthermore, no doubt many a thing will come to hand which "exchange men" would like to see printed in The Mechanic for the use of our thousands of readers—for the success of our little venture is most marked;—publicity will be given to all such as may prove of real interest to the class for which it is designed.

Much of the matter and illustrations already volunteered by contributors has proven of great value to the readers in general; in fact, hundreds of them have informed us that one or two things, instancing them, have proved, to them, worth fifty years' subscription to the journal. We do not doubt it, or that what they in return have forwarded for publication or exchange has been found of equal value to those concerned.

We leave the "exchange" matter entirely in the hands of our readers; it is for them to determine whether it shall be carried to a successful issue or no. If they take our advice, they will immediately set to work, and, in addition, not forget, in the fast approaching festive season, to wish success to The English Mechanics' Exchange.

CLAY BINDERS IN SOLDERING.

Sir John Robinson says that the Asiatic goldsmiths seldom use binding wire for light work, they have always beside them a little dish of a tempered mixture of clay and sand or powdered brick, with little portions of which they form connections and supports for the pieces they mean to solder together. Thus, if two tubes have to be joined in the form of the letter T (inverted whilst being soldered), they first warm the lower piece, and then dab on a little at a time of the mortar (leaving the joint clean) until the inclined props of the clay run high enough nearly to touch the upright piece, which being warmed and set in its place, the connection is completed by a further addition of the mortar, which, when heated over charcoal, becomes quite firm, and supports the pieces whilst the solder is running, even in works of pretty considerable size.

THE ENGLISH MECHANIC.—HIS RISE AND PROGRESS.*

(*Continued from page* 113.)

If I rightly understand these societies, they are in the highest degree calculated to elevate and to render more efficient the class for whose benefit they came into being. Studiously marking out for avoidance the dangerous rocks and quicksands of trade politics, the framers of our rules, the honoured founders of this Association, drew up a code of laws which must, if strictly adhered to, save our barque from shipwreck; and strictly has it been hitherto, and will it be in the future adhered to, I am certain. This Association, I need scarcely tell my present hearers, does not consist of a band of scientific "Fenians," meeting in secret conclave, and meditating the ruin of their rulers—the Master Engineers of Great Britain; but rather is it a gathering of workers in the fields of wisdom endeavouring to glean facts which shall make them better men and better agents of their employers. It is astonishing to us that any members of the last-named class should have ever entertained an opposite opinion of our meetings and of our proceedings. The mistake into which they fell, nevertheless, was perhaps a natural one; it has passed away, and it is not for me now to call up its ghost. Employers have attended our gatherings, have partaken of our festivities, and have complimented us upon our growing numerical and financial strength. In this latter respect, too, they have materially assisted us. If, unhappily, differences have during the current year arisen in regard to the dispensation of a certain portion of our funds, those differences exist no longer—at least, they do not actively exist; and in a latent form, so far as we are concerned, at least, they have died out. We regret that they ever manifested themselves, and are anxious only to maintain peaceful and pleasant relations with one and all the employers of engineering labour in the United Kingdom.

It has been my warmly-cherished desire from the moment when your unanimously accorded suffrages first placed me in this chair, down to this hour, to obtain for this Society the good opinion and the co-operation of master engineers. I believed, at first, that the clouds of misconception through which the Society was seen by the employers, and which gave them a distorted notion of our doings, might be dispelled, and dispelled, I am thankful to say, they have been. This Association, of which I am proud to be a member, stands now before the general engineering community in its true light, and I believe is estimated at something like its real value. It is understood to mean a community of men of similar occupations, similar habits, and similar ideas, associated together in friendly union, for mutual improvement and material good—and that is precisely what it is.

It has been said, that the foreman engineer graduates in the workshop—our meetings enable him to continue his studies, and to keep pace with the rapid mechanical and scientific advancement of the time. True, the Association has not attained to the dignified position occupied by the Institution of Civil Engineers, or by that occupied by the Mechanical Engineers, but it is following worthily in their wake, and I for one do not despair of its rising—though perhaps not in my own day—to something like their eminence and usefulness. It has been urged, tauntingly, against the members of this institution, that they assemble in a tavern; but the fact is, that their limited funds will not as yet allow of their doing otherwise. There is no doubt that the great majority, if not all the members of the London Association of Foremen Engineers, would gladly meet in a hall, which they could call their own; but the very practical question next arises—where is the money to come from for providing it? The Association is on its legs, and it is walking, but it cannot *run*, it needs more steam to accomplish that performance! We are far from being without hope, that that "steam" will one day be generated, either from the action of internal fire, or the application of external fuel. Like Shakespeare's lean apothecary, we must plead in extenuation of our shortcomings, that our poverty and not our will conduces to their perpetuation.

Besides, there are illustrious precedents to which we may refer in justification of our present place of meeting. The Institution of Civil Engineers may be said to have been born in a tavern—the "Crown and Anchor," in the Strand, and at the Freemasons' Tavern it was for many years nursed and fed.

Before the year 1760, the title of Civil Engineer was almost unknown in this country. In nearly all other nations of Europe, Civil Engineering was, at the date named, a profession encouraged or instituted by their Governments. The extension of manufacturing and mechanical industry at home about that period, and which state of things was so admirably described by Mr. Robertson last month, really called into existence the English civil engineer. It was seen that it would be better for establishments to be placed in new situations, adapted to the ready obtaining the raw materials, than to endure the delays and vexations to which they were exposed in corporate and privileged towns. This produced a new demand in the country—internal navigation and better roads. To make communications from factory to factory, and from warehouses to harbours, as well as to carry raw materials to manufactories, became absolutely necessary. Hence arose works not of pompous and useless magnificence, but of practical utility. Our seaports were previously as nature had left them, despite the construction, in some instances, of jetties and piers of defence. All these things and many more of a relative character, tended to the natural creation of the civil engineer; the mechanical engineer being his undoubted progenitor.

From the earliest notices of the new profession, it appears that its followers entertained that jealously of each other which is even new to come amongst the cultivators of what are known as the liberal arts. They met in the avenues of the two Houses of Parliament, and in the committee-rooms, and each maintained the advantages of his own plans with pertinacity, and occasionally, it is said, with pugnacity. By this time Smeaton had appeared upon the scene, and was playing an important part in the drama of civil engineering. It was proposed to that remarkable man, whose career has been fully recorded by the indefatigable, but somewhat romantic pen of Mr. Smiles, that such a state of the profession, then crude and in its infancy, was highly improper, and that it would be well if some some sort of meeting or an occasional *soiree* were to be held, where they might shake hands together, and become personally known to each other. Who the gentleman was that made this excellent suggestion is not known, but he was certainly the indirect originator of the Institution of Civil Engineers. Mr. Smeaton at once comprehended the propriety of such meetings, and the first one took place in 1771. During the succeeding twenty years the new Association made little progress, for at the end of that period it numbered only sixty-five members, not more than fifteen of whom were real engineers, employed in public works of any magnitude; the others were amateurs, or ingenious and inquiring workmen, and artificers. In 1792, the Society of Civil Engineers, as it was then termed, ceased to exist *pro tem.*; in fact, it was dissolved by mutual consent of the principal members. The untoward conduct of one gentleman to Mr. Smeaton was the cause of this disunion.

In April, 1793, the society was reorganised. Mr. Smeaton, who had consented to rejoin it, having, however, died in October of the year preceding, the title was retained, and henceforth the members met on every alternate Friday, at the Crown and Anchor Tavern, during the Sessions of Parliament. One of their earliest labours was the publication of the reports of Mr. Smeaton. It does not appear that the principles of the society could ensure its permanent stability, for those reports form the only record of its transactions, and it merged into a club called the "Smeatonian Society of Civil Engineers," and which, for a considerable period, held its meetings at the Freemason's Tavern. Its rules were very exclusive, and the result was the formation, by some of the young engineers of the day, of an offshoot institution, avowedly for the purpose of mutual improvement, and this formed eventually the necleus—the germ of the present Institution of Civil Engineers. The first six gentlemen who associated were Messrs. William Maudslay, H. K. Palmer, Joshua Field, James Jones, Charles Collinge, and William Ashwill. Their first meeting, also at a tavern, was held on the 2nd January, 1817, and the meetings were continued until the 3rd of January, 1820, when Mr. Telford, then in the height of his fame, was requested to join the society. He did so, and on the 21st of March following he was installed as President. Its subsequent removal to Great George-street, and the valuable services it has rendered and is still rendering to the country, are sufficiently well known by all, and need not, therefore, be further dwelt upon at present. It may be stated, however, that, with all its advantages, the Institution of Civil Engineers did not possess, until very recently, that necessary adjunct—a Benevolent Fund, for the relief and solace of its decayed and unfortunate members. It is not

* A paper read by Mr. Joseph Newton before the London Association of Foremen Engineers, November 4th, 1865.

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long, indeed, since a gentleman connected with the institution, who had rendered much service in his day to engineering science, and who came distinctly under the category "unfortunate," applied to the members of this Association for relief—and did not apply in vain. The founders of this society had not overlooked the possibility of some of its own associates being worsted in the stern battle of life, and, so far as it was possible, they provided against such contingencies. In my own mind I feel convinced that the case to which I allude was the proximate, if not the immediate, cause of the establishment of a Benevolent Fund in connection with the Institute of Civil Engineers—a fund which, had it existed, as it should have done, from the first, would have saved many of its members from humiliation and suffering, and itself from reproach.

(*To be continued.*)

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

SILVERING MIRRORS.

Sir,—In an article entitled Silvering Mirrors, which appeared in your valuable journal some weeks since, you stated that the reducing agents used by manufacturers were kept secret by them. From several scientific works I have gathered the following receipts, which will, I hope, serve to show the sort of articles employed.

Saccharic acid is added to nitrate of silver, and then ammonia to the resulting solution—a white powder falls; this is put on the glass to be silvered, and the whole is gently warmed; a smooth coating of metallic silver is thus given to the glass. Saccharic acid may be prepared on a small scale in the following manner:—One part of sugar, two of nitric acid, and ten of water are heated together. Chalk is afterwards added to neutralize, and the mixture is filtered. Sugar of lead is then added, the powder which precipitates is washed well in water, and exposed to a stream of sulphuretted hydrogen gas. Black sulphide of lead precipitates, and a solution of saccharic acid remains; this may be concentrated and added to the nitrate.

Drayton's process, as now practised successfully in Paris, is the following, viz.:—"600 grains of neutral nitrate of silver are dissolved in double their weight of water. To this are added the following five solutions: No. 1, 75 grains of a liquor composed of 25 parts of distilled water, 10 of carbonate of ammonia, and 10 of ammonia (of Sp. Gr. 0·98). No. 2, 30 grains ammonia same strength as last. No. 3. 1,800 grains alcohol (Sp. Gr. 3·85). The mixture is then put aside to settle. The clear liquid is then poured off, and No. 4 is added; it is a mixture of equal parts of alcohol (same strength) and oil of cassia. This is added in the proportion of one part of the essence of cassia to 15 parts of the silver solution. The mixture is now agitated, and left to settle for several hours; after which, it is filtered. Just before pouring it upon the glass, to be silvered. No 5 liquor is added; this is essence of cloves, composed of one part oil of cloves and three of alcohol, same strength as before. This liquor must be in the proportion of 1·78th of the bulk of silver solution. The glass, which has been thoroughly cleaned, is covered with the silvering solution, and warmed to about 100° Fah., and it is kept at that temperature for two or three hours; the liquid is then decanted, and may be employed for silvering other glasses. The deposit of silver on the glass is washed, dried, and varnished."

As oil of cassia and cloves are expensive, instead of them, an alcoholic solution of grape sugar may be employed, but the deposit occurs more slowly.

Petit Jean has suggested a very good method of silvering glass. He employs a solution of tartrate of silver in ammonia. By using a solution of citrate of gold in ammonia, it is easy to gild glasses, and glass may also be platinized by employing sodic tartrate of platinum.

VINCENT C. DAVIS.

SAFETY VALVE.

Sir,—In my last communication to you, under the heading "Multum in Parvo," I drew attention to the incorrectness of a solution given by G. S. to a question relative to the safety valve, and I am sorry to find that a J. S., in attempting to correct the former correspondent has fallen into the same error, and made it infinitely worse by multiplying where only additive quantities should be introduced. This latter error may be due to typography, but the omission of considering the safety valve lever as one of the third order, and treating it accordingly, cannot be traced to the same source, and is, therefore, a *bona fide* error on the part of both writers.

If you will favour me by reproducing the sketch sent by J. S., he will find that his formulæ should originate from $\frac{(a \times b)c}{b}$, and not $\frac{a \times c}{b}$, and the effect of the weight of lever and valve are additive quantities, and not multipliers in the formulæ. The weight of valve, as compared with the area under high pressure, is so small that engineers generally do not take it into consideration; but the effect of the lever is a matter of some importance, and J S. has not shown your readers how it is to be estimated, although that is really the only difficulty connected with the safety valve lever, and hence deserves a fair consideration.

In such a lever having first ascertained its height, it is necessary to find its centre of gravity, which can readily be done by balancing it on a chisel point fastened in a vice. The distance from the fulcrum of this centre being formed, the lever must be considered as one without weight in itself, but having a weight equal to its own hung on at the centre of gravity, and its effect found in accordance with the rules for levers of the third order previously given, and in forming an equation, this, which is constant, must be added to the effect of the weight or tension of spring used to keep the valve down. I may add that one reason why the weight of valve is rarely, if ever, taken into consideration is this:—The form of the seating being conical, from the moment the valve is first raised, the steam is operating upon a greater surface, and, consequently, it requires less pressure to maintain the valve in its lifted position than it did to raise it, and hence the safety valve never truly indicates the exact pressure in the boiler when an engine is blowing off.

In conclusion, both G. S., and J. S., have gone aside from the original question, they set out to solve, and which, I regret to say, my leisure is too limited to deal with; but it is one worthy of a prominent position in your columns, being both interesting and useful, and I hope to see a correct solution yet from the pen of some of your talented correspondents who may have the time and ability to deal with it.

WM. TONKES.

Sir,—I don't often presume to interfere with scientific or other explanations kindly given in answer to the queries of a correspondent, but in your last number, Mr. E. Gregorio's dissertation upon the action of our chief luminary as a volunteer fire-engine is a trifle too far removed from the line of fact and truth to pass unchallenged.

Firstly. The Imperial Magazine of 39 years back is not a very reliable authority on questions of theoretical science, I beg to submit.

In the next place, atmospheric air being a simple mixture and not a combination it can never become decomposed by passing through fire or anything else; and the rays of the sun have not any tendency to draw off oxygen from either air, or the constituents of a coal fire. Further, if a parlour fire (or any other) be long left without attendance—is not open to a strong current of air, and is not well supplied with combustibles—my personal experience is, and I think I shall here be borne out by some few thousands of your readers, that the fire inevitably goes out, whatever meteorological phenomena may be occurring at the time, for the precise reason that a man dies when starved and suffocated there being nothing to keep him alive.

Theoretically, the action of a very powerful summer sun upon a fire is to slightly diminish the draught by raising the temperature of the air-current before it reaches the fire; but practically, this action is so extremely infinitesimal as to be quite inappreciable. When a fire is exposed to strong sunshine, its apparent brilliancy is lessened considerably (just as a gas flame is often invisible in daylight), and it may appear to be almost out, although in a slightly darkened room it would seem to burn vigorously; but the sun has really no effect whatever in extinguishing a fire any more than the interposition of a poker above the grate has the faculty of drawing it up, as some would have us believe

Mr. J. S. Thompson is not more happy in his attempt to account for a phenomenon which never occurs except as an old woman's story. White light is perfectly imponderable, and, consequently, can be neither a conductor or a non-conductor of heat, while the effect of a blanket enveloping a person whose garments are on fire is not due to its non-conducting properties (which, *cæteris paribus*, would rather assist the fire than otherwise, acting like fire-brick or boiler-felt), but simply to the fact of its cutting off the supply of air more or less perfectly.

Referring to the subject of electrical condensers (Messrs. P. Stodhard and E. Furze), alternate sheets of new tinfoil or gold leaf, and of that very thin gutta-percha known as satin or strained sheet, will be found to answer the purpose indicated.

Under the head of a Vehicle for Colour. I find a recipe given similar to that I originated and published some ten years ago in *The Builder*, with the title of "The Exeboracic Paint."

WENTWORTH E. SCOTT, F.C.S.

Analytical Laboratory, Westbourne Park, Bayswater, London, W., Nov. 25, 1865.

MAGNESIUM.

Sir,—In your general notes you say that magnesium has little tendency to oxidize in the atmosphere. I left a small piece of the wire exposed to a very damp atmosphere for some time, and it became very much corroded. The electric conductivity of magnesium is 25, iron 20, and copper 100. Now, copper is much cheaper than magnesium ever can be. Iron, though not quite so good a conductor, is much cheaper than either. But, supposing that magnesium was used, its light-giving property is so well known, that I should not wonder if some miscreants were to apply a light purposely. Then the continuity of the line would be destroyed.

JAMES P. BLACKMORE.

Sir,—Your compositor has made me write dreadful nonsense In the 31st and 32nd lines of my letter, in No. 36 of THE ENGLISH MECHANIC, I appear to recommend Magnifier to buy a reconnoiterer telescope of Salmon and Co., Princess street, Edinburgh, (£10 10s.! sent free.) This should be Salom and Co., Princes-street, Edinburgh, (10 shillings and 10 pence, sent free) I should scarcely stultify myself by recommending a ten guinea telescope to a man who wanted to obtain one for twelve and sixpence.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

OUR SUBSCRIBERS' NOTES AND QUERIES.

SOUND GLUE.—Can any of your readers inform me of a cement or glue which will not be affected by water or naptha?—WILLIAM JACKSON.

Sir,—Can any of your readers give me information respecting square thread screw cutting, more particularly as to existing patents relating to it?—INVENTOR.

Sir,—Can any of your readers tell me how to make a black for blacking cold iron, that will dry quickly; also how to make a black and green paint or varnish for metals that dries in about ten minutes?—WALTER WILSON.

THE PLANETS.—Will a Fellow of the Royal Astronomical Society inform me why the planets describe ellipses?—C. T. WHITMELL.

JAPANNING.—Will any reader tell me how to japan tin trunks?—B. HICKMAN

FUSING GLASS.—Can any of your readers inform me of any kind of flux for fusing glass at a low temperature, and which will afterwards bear a heat of 600° or 700° Fahr? I believe the German glass-blowers use something of the kind in soldering their chemical apparatus, &c.—E. F. G.

BAROMETER.—Can any of your readers tell me the best way to proceed in boiling the mercury in a barometer to expel air? The tube is 1-5th of an inch bore and ¼ an inch external diameter, and I am afraid of cracking it in the operation; also, where to obtain ivory for the scale and vernier. I want it in the rough as I can polish and divide it myself?—BREAK DOWN.

A CHEAP GAS APPARATUS.—Perhaps some of your numerous readers could inform me how to construct a cheap and simple apparatus for making oil or coal gas, such as would supply a working man's cottage of two rooms and kitchen, with certain safety from bodily injury! Any one giving full dimensions of retorts, purifier, gas-holders, and all other other additional connections in as brief a manner as possible it will be thankfully accepted.—AN ECONOMIC CITIZEN, Glasgow.

INDIA-RUBBER.—Can you or any of your readers inform me, first, of a cheap and easy method of vulcanizing small articles made of pure sheet rubber, that they may resist cold, and not be much affected by acids?

2. Is the vulcanite or dental rubber used by dentists plastic or hard, when supplied from the manufacturers?

3. If plastic, how vulcanised after moulding to prevent getting out of shape? If hard, how softened sufficiently or moulding?—GUILLAUME.

TURNING.—Can you or any of your readers inform me how the thread is cut in end grain mahogany, such as drawer knobs, &c., and a plan of tap?—G. D. J. Y.

TIN CUTTINGS.—Can any of your numerous contributors inform me the way to extract the tin from the cuttings of sheet tin? I want to save the tin and iron as well.—W. AUSTIN.

SLIDE RULE.—Can Mr. Tonkes inform me of any rule whereby I can bring a decimal into a fraction on the slide-rule at one setting of the slide?—C. B. M. S.

ELECTRICITY.—Will Mr. Tonkes or any of your readers kindly inform me how to construct an ebonite plate for an electrical machine, or where I can purchase one, and the price of one about one foot in diameter? also, what kind of cushion for the rubber is required to excite the plate with?—THEO.

MAGNET.—I tender my sincere thanks to Mr. Tonkes for his promptness in replying to my queries. He would still more oblige me by telling me the number and length of wire coiled on the temporary magnet in magneto-electric machines?—J. C. WIGG.

BRONZING.—I have a bronzed coffee pot which has been cleaned with sand, and is now no better looking than one made in tin. Will any one kindly tell me how to re-bronze it, so as to get the proper warm chocolate tint?—CHANG.

TURNING AND ELECROTYPING.—Can you or any of your correspondents inform me of any work that treats of the geometrical chuck and medallion turning? and is there any mode of electrotyping on gutta-percha—I mean a deposit of iron?—SUSANNA.

I will take the liberty of asking your correspondent, Mr. Tonkes, one question:—How can I couple four cells of Bunsen's pile for quantity? By coupling one zinc with the next carbon, I can get a current of considerable intensity, but I have hitherto failed in all my trials to couple for quantity.—VINCENT C. DAVIS.

THANKS.

Sir,—Will you kindly insert my thanks to Mr. Furze. I have obtained Mr. Culley's work through my bookseller and have found it an exceedingly good one.

E. McG.

Sir,—If Archimedes will communicate with me, I shall be happy to give information on the machine in question.

16, Market-lane, Ipswich. GEORGE H. SMITH.

OXIDATION.

Sir,—In answer to Sparrow Hawk, in No. 33, I beg to inform him that one part "fat" oil varnish, five parts highly rectified spirit of turpentine, is the best thing I have ever tried for preventing oxidation on bright surfaced steel.

CINA.

CHEMIST'S FOLDING MACHINE.

Sir,—In answer to Archimedes, I beg to inform him that I do not know that the chemists' folding machine has been the subject of a patent, but think it would be to his benefit to send his address to Mr. J. Dickinson, South street, Stockton.

L. F. R.

GAS.

Sir,—Dr. McCann will best economise his gas by taking off the elbow, and putting some coarse wool in and pushing it as near the burner as he can, and just tight enough to prevent the gas from flickering when it is full on at the main; this will require readjusting once or twice perhaps.

Then turn the gas down at the main, so that there is no more supply than the actual consumption; the result will be a steady light with a great saving of gas. I have had all my burners so treated for the laft 10 years.

My best thanks to Mr. Merritt, and others of your correspondents.

D. DAVIES.

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Sir,—I am surprised at the letter of Mr. Jackson, wherein he states that his patent renders my invention invalid. He seems to imply that they are one and the same thing. I do not thoroughly understand the particulars of his boilers, but I think that if they were compared, they would be totally different, although they both embrace the same principle, viz:—the generation of steam by gas heat.

A. H. SADLER.

4, Richmond-place, Richmond-road, Dalston, N. E.

MAGNET.

Sir,—In answer to your correspondent, J. C. Wigg. A permanent magnet is made of hardened steel, and made magnetic by being rubbed with a powerful magnet or a loadstone. An electro-magnet is made of soft iron, round which is a coil of insulated wire, the ends of which are connected with the two ends of a battery.

R. W. WILLIS.

DANIEL'S BATTERY.

Sir,—Alfred Crofts will find full instructions to construct a Daniel's battery in Dr. Lardner's electric telegraph, page 126. Walton and Maherty, Gower-street, London. Price 1s. 6d. I should be very happy to lend him my book, if he is within call, or send his address.

D. DAVIES.

TELESCOPE.

Sir,—I hope you will give me space to answer, as well as I am able, the query of your correspondent, Magnifier, and that he will excuse my doing so, as his question is addressed to a particular person.

An astronomical telescope requires only two lenses; an object and an eye glass; both convex, and the object looked at will be reversed, but if the eye glass be concave, it will be erect. Fix the object glass at the end of a tube, say of tin, and the image of the object at which it is pointed will be reflected within the tube at its focus. Now place the eye glass exactly at its focal distance from this image, or distant from the object glass the length of both, and the telescope is complete. Suppose the object glass to be 36in. focus, and the eye glass 1in; they must be placed 37in. apart, and will magnify 36 times. Of course, in two tubes, the object glass in a large one, and the eye glass in a small one, to slide in and out, so as to adjust the focus to the vision of the observer.

A terrestrial telescope requires two additional glasses. To correct the inversion of the image, place the object glass at the end of a tube as before; if 36in. focus, at 37in. distance; fix a 1in. glass at 2in from this, another 1in. glass now at the focal distance from this, an erect image is forward, which is to be magnified by a fourth glass of 1in. at a distance of 2in. from the last. To find the focal distance of a convex lens, hold it up to the sun against any object until the sun's image is clear and distinct; the distance between the glass and the sun's image is the focus. The flatter the glass the longer the focus. Of course, the more globular the reverse. To find the magnifying power of a telescope, divide the focus of the object glass with that of the eye-glass, and the quotient is its magnifying power.

A. PEARCE.

Sir,—In reply to D. D. D., in No. 36, referring to coupling motive power:—

If he would say what pressure is got on pistons at commencement of stroke, and where cut off, with diameters of cylinders, length of stroke, number of revolutions of crank shaft per minute; also, diameters of oscillating cylinders, length of stroke, and pressure expected to work at. If these particulars are furnished, he may probably hear something more about it.

A. STOKES.

ELECTRO MAGNETISM.

Sir,—In No. 33 of THE ENGLISH MECHANIC is a letter signed J. Tawse, suggesting the practicability of propelling vessels by electro magnetism by means of sheets of metal covering the sides of the vessel acted upon by the salt water, thus converted into a battery. I do not know if Mr. Tawse is aware of his suggestions being put to practical experiment about a month ago in the harbour of Ostend, and, to a certain extent, with a very satisfactory result.

If the suggestion applies to practicability without regard to expense caused by the destruction of the metals, I think from what I saw that it is quite possible. The experiment I witnessed was tried with a small rowing boat, which was propelled by a screw at about the same rate as with an oar; and, as I thought, very cleverly and with much promise. If by increasing the number of plates we can increase the power to any extent, I think it quite practicable, and every way worthy the attention of those who have the means and disposition to follow it up to a successful result.

R. W. WILLIS.

QUADRANT.

Sir,—J. M. S. may mark slot links on paper in the following way:—

Draw an end view of the crank and eccentrics on card: upon your paper draw a centre line, supposing it to be the centre of slide spindle and crank shaft, draw another line crossing at right angles, near one end of your paper; pass a pin through the centre of the cardboard crank shaft, and fix it to the point where the two lines cross, so that you can place it in any position. The four lines will guide in placing the crank, with the distance between the centre of formation of the sheave, and the centre of the slot in the link, in a line with the rod in your compasses, the position of both ends of the link can be found in any part of the shaft's revolution, with the distance you have for a radius describe an arc from each end of the link, and then with the same radius from the point of intersection, describe the centre line of link.

A valve moves when gear is middled, because, during a rt of each stroke both rods are going the same way. For this reason the middle of a quadrant always moves backward and forward.

Know, then, Inquiring Jamie, that the radius of a quadrant is the distance from it to the centre of formation of the sheave; or, if it be one which does not lift, but has the die lifted in it, the length of the connecting link between the die and slide spindle is the radius.

F. H. F.

THE LINK MOTION.

Sir,—In reply to J. M. S., the steam will blow off at 69 pounds pressure per square inch, and the weight must be placed 8 inches from the fulcrum to correspond to a pressure of 60 pounds per square inch.

With reference to the link motion, the travel of the valve when the link is in mid-position is due to the eccentric rods being necessarily crossed and recrossed during each revolution of the engine; what is due to this cause varies from ⅛" to ⅜", more or less, according to the throw of the eccentrics. In that form of link motion with the rods connected in a line with the valve spindle, it does not affect the valve at all (unless the steam is being worked expansively, when, of course, the link is nearer its mid-position), because the vibration of the link destroys the effect this motion would otherwise produce. But, in the link motion with the rods connected at the ends of the link, care must be taken in setting the valve to see that the rods are crossed on the crank when the link is connected direct to the valve spindle, and *vice versa* when connected to a gab lever. If this is not properly attended to, the valve will have lead on the one side, and lap on the other; but if the rods are crossed, as shown above, instead of the lead being destroyed (when working expansively), more lead is given the nearer the link approaches the mid position.

To see this more clearly, let us, for example, take an engine with neither lap nor lead on the valve, the link fitted direct to the valve spindle. Now place it in its mid-position, the engine on the bottom centre, and the eccentric rods open on the crank. Now, the valve having no lap, the least motion that is imparted to it either way will open the ports; then, if we turn the engine on the top centre, the eccentrics will be reversed, and the rods, consequently, will be virtually shortened, the amount due to the crossing of the rods.

I might have gone further into this interesting subject, and shown by diagrams the position of the valve at different parts of the stroke; but, if J. M. S. will construct a model of the link motion and valve, he will understand it far better then I can show him on paper.

A Common ⅛" places the eccentrics on true enough, only it is more true and scientific to draw a line parallel to the centre line at a distance equal to the lap + lead, instead of setting it off with a pair of compasses, for, by that means you get the proper angle, when, according to his method, the angle would be too acute.

M. J. WHEATLEY.

A CHEAP TELESCOPE.

Sir,—I remit you for insertion in Notes and Queries of THE ENGLISH MECHANIC, the following suggestions to Athelstane. Magnifier, and others, for the construction of a cheap telescope for observing heavenly bodies. Procure from an optician a 35 inch object glass (that is, a convex glass which produces a focus of the sun's rays at the distance of 36 inches), and a 1 inch eye glass (that is a convex glass, producing a focus at 1 inch); employ a tin plate worker to make two tin tubes, without lapjoints, one 30 inches long, and about one and a quarter inch diameter inside the other, twelve inches long, and its diameter such that it will just slide comfortably inside the larger. The inside of these tubes should be first painted or otherwise lined with a dull black. At the end of the larger tube an ingenious workman will have no difficulty in securing the object glass, so that not more than an inch diameter of it shall be exposed, and at the end of the smaller tube the eye-glass must be fixed. When the open end of one tube is inserted in the open end of the other, so that the two glasses shall be about 37 inches apart a telescope will be present which will magnify the diameter of objects 36 times, or, in other words, will make heavenly objects appear 36 times nearer. With such a telescope, the satellites of Jupiter, the crescent of Venus, and the inequalities of the surface of the moon may be distinguished. Galileo's telescope, with which he made the first discoveries in the heavens, did not magnify more. I need scarcely add that with this instrument all objects will appear inverted; but, with regard to celestial objects, this is of no importance.

This telescope I describe costs about 4s.; but for double that sum, a very much superior one may be constructed, by obtaining a larger and better object-glass of 40 to 48 inches focal distance, the cost of which is 4s. 6d., retaining the one inch eye-glass, and having the tubes made to suit the additional greater length of focus and diameter of object glass, the possession of such a telescope may add greatly to the pleasure and instruction of those who have any taste for the sublime and wonderful facts of astronomy.

AN ECONOMIC ARTIZAN, Glasgow.

PHOTOGRAPHY AND ARTISTS.—Last week at the Associated Arts Institute, Mr. O. G. Rejlander read a paper on the Uses of Photography to Artists. The paper was illustrated by a very large number of transparencies—some enlargements, others reductions—from the better known of Mr. Rejlander's productions. Besides a number of studies from the nude, he also exhibited a large chalk drawing of Mr. Brougham, the eminent actor, made from a small photograph. In the course of his paper, Mr. Rejlander called particular attention to the value to artists of an enlarging apparatus for the amplification of small sketches, and exhibited, in an arrangement of his own, some enlarged transparencies by the aid of magnesium wire.

THE ENGINEER'S SLIDE RULE.

We are compelled through press of letters and other unavoidable circumstances to defer Mr. Tonkes' third paper on the slide rule for a week. Two papers have yet to be published.

BORING, DRILLING, &c.

As it is thought a short chapter on broaches for making rafter holes would be acceptable, it is therefore given herewith, together with the necessary illustrations. The tools are much less varied than the drillers and borers for cylindrical holes. For instance, the carpenter employs only the rimer, which is a fluted tool like the generality of his bits. It is sharpened from within, as shown in Fig. 1, and thus is fitted to act like a paring tool. Such articles as the flute are first perforated with the nose bit, and then, by means of tools of this kind, broached with taper holes, the tools bring very carefully graduated as to their dimensions. Figs. 2A is that of a German rimer, and is used by wheelwrights for inlaying the boxes of axletrees. It will be observed that the loose blade is separated from the shell by the introduction of slips of leather, or wood; also, that the detached cutter fits on a pin in the front end, and is fixed against the shaft by a collar. What is known as Hilton's rimer was invented for the purposes of the wine cooper, and by it holes are made more truly circular and the shavings prevented from dropping into the cask. Fig. 2 is a section of the stock of the instrument which consisted of a hollow brass cone, down one side of which was a slit for containing a narrow blade or cutter, fixed by screws fixed diametrically. Thus the tube was turned into a conical plane; the shavings entered within the tube, and were removed by the small end of the cone, which was fitted with a cork. Broaches for metal are of various sections, and solid; thus in Fig. 3, the half round, the edges are rectangular—more commonly, the tool is polygonal, as in Fig. 4, except that they have 3, 4, 5, 6, and 8 sides, and that their edges measure respectively 60°, 90°, 108°, 120°, and 135°. The 4, 5, and 6-sided broaches are perhaps the most general. What is called the watchmaker's broach is simply a burnisher. Ordinary broaches are very acute, and Fig. 10 represents the general angle at which their sides meet—less than one or two degrees; the end is chamfered off with as many facets as there are sides. Spare broaches are sometimes, after having been filed up, twisted whilst red hot, as shown in Fig 9, where the rectangular section is very slightly disturbed, though the faces become a trifle concave. Whatever advantage, then, is to be attributed to the screw form: as, turned in the direction of the twist, it cuts greedily, in fact, is disposed to dig over forcibly. When turned against the twist, it requires more pressure than those broaches not twisted. The evil in this broach is that if it is bent in the direction of its length in twisting or hardening, correction is inadmissable by grinding—consequently, its use is restricted, though we fancy a carefully wrought and heated tool, hardened before the tang is squared up true, would be found a rare acquisition.

Broaches are also made for perfecting cylindrical holes. Then the broaches are made almost parallel, or a trifle the highest in the middle. Figs. 6 and 7 show them filed, with two or three planes at angles of 90°. The circular being a non-cutting part acts as a more certain base than when the tool is a polygon. The stems are made so as to pass entirely through the holes, and the tool is perhaps better known as a finishing drill than a broach. The size of the parallel broach may be increased by placing a slip of leather at the convex part. Square broaches are used to broach gun barrels, and the cutting parts of these are about 8 or 10 inches long. They are packed on four sides with wood spills to complete the circle (See Fig. 8, in which the tool is shown supposed to be at work). The bit is progressively enlarged by the introduction of thin slips of paper between the wood spills and the broach; for the paper, it will be seen, throws the one angle more towards the centre of the hole, and so gives a corresponding advance in the cutting angle. Philosophical instrument makers, in finishing air-pump barrels, use a broach which consists of a thin plate of steel inserted diametrically between two blocks of wood—thus producing a cylinder with a scraping edge in advance of the wood.

According to size, broaches are fixed in handles, like bradawls, or used in the brace, or in the tap winch; or, again, in the lathe like a drill. For large works broaching machines are used, being but little more than driving gear ending in a sort of universal

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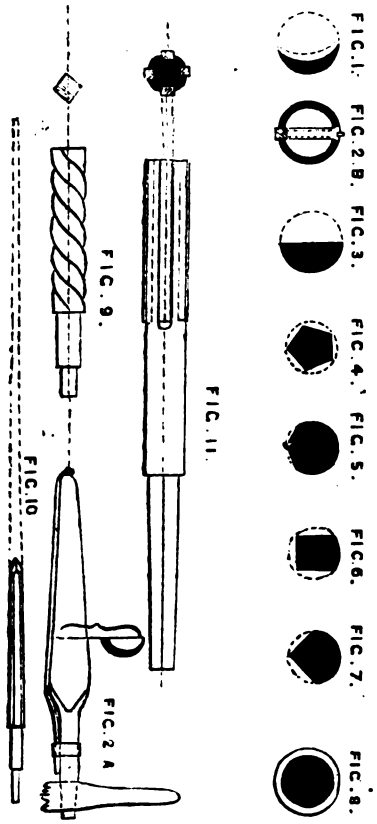
joint, to lead the power to the tool, which may be left under the guidance of its own edges, according to the common principle of the instrument.

The penetrating angles of broaches and drills are more obtuse than in tools for turning; and, on account of the extra friction excited by the nearly rectangular edges, it is usual to employ a lower velocity in boring than in turning equal diameters, so as not to soften the tool by the generation of heat; and lubrication is more necessary in boring and drilling than in turning. Mr. Holtzapffel, in his book, further says that "drills and broaches form together a complete series. First, the cylinder bit, the pin drills, and others with blunt sides, produce cylindrical bodies by means of cutters at right angles to the axis; then the cutter becomes inclined at about 45°, as in the common piercing drill and cone countersink; the angle becomes much less in the common taper broaches, and finally disappears in the parallel broaches, by which we again produce the cylindrical hole, but with cutters parallel with the axis of the hole." Still, considering drills and broaches as one group—drills have thin edges, yet require the screw to put them to thin work; and though broaches have more obtuse edges, yet, because the pressure is at right angles to the cutting



edge, the greater force is supplied without a screw. Glancing at Fig. 10, and supposing the dotted lines to represent the extension of the sides to a point, the length, it will be seen, exceeds the diameter by many times, and, as Mr. Holtzapffel lucidly observes, by that number will the force employed to thrust forward the tool be multiplied, the same as in the wedge, and the broach being confined in a hole, cannot make its escape, but acts with great lateral pressure directed radially from each cutting edge, and the broach, under proper management, leaves the holes very smooth, and of true figure.

But we had nearly forgotten a point or two. countersinks, minus a point, are made sometimes as solid cones, with a groove up one side for the reception of a cutter, deepest toward sthe cone's base (Fig. 5). The celebrated Mr. Richard Roberts' broach (Fig. 11) has four detached blades introduced, so as to more easily retain the angle of the broach, which blades are a trifle wedge-form in section and extension, to constitute the cone and cutting edges, and the grooves are also rather deeper behind. In restoring the blade edges, they are removed from the stock, and their angles tested, and to compensate for loss of thickness, they are set nearer to the point when replaced.

BARCLAY'S INJECTOR.*

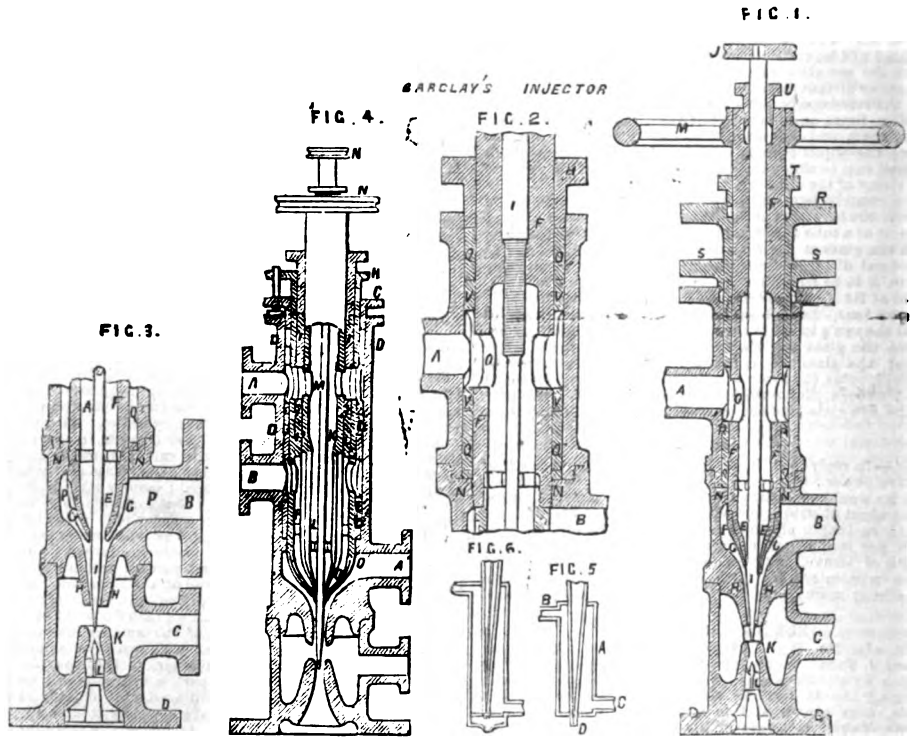
This invention of Mr. Andrew Barclay, of Kilmarnock, consists chiefly in extending the annular nozzle used in instruments for injecting liquids, through which the liquid passes, to a much greater length than has hitherto been accomplished; also, in forming an annular passage beyond the first-mentioned nozzle, for the purpose of obtaining an annular sheet of steam or water after the stream has passed through this nozzle; by which arrangement a far superior force, both for raising and also for forcing fluids generally, is obtained.

Another improvement involves the forming of a tapered or conical condenser, into which steam or other condensible vapour is admitted, in such quantity as may be required for the purpose of injecting or ejecting fluids. In this arrangement the fluids, either injected or ejected, have imparted to them the momentum of the fluid, moving with the velocity of the vapour used rushing into a vacuum. In this apparatus the condensation may be effected in any of the modes generally used for condensing steam or other vapours.

The apparatus consists essentially of a hollow truncated cone, terminating in a nozzle placed inside a hollow cylindrical vessel, in which vessel the condensing fluid is admitted, so that it condenses the injecting or ejecting fluid or vapour, thereby producing a partial vacuum in the conical chamber. The fluid to be injected or ejected is admitted through a suitable pipe or duct connected to and passing through the side of the outer vessel into a conical one, whence it is injected or ejected through the nozzle at its extremity, passing thence to any place where it may be required.

In Plate IX., fig. 1 is a vertical section of the improved apparatus. The steam enters by the branch pipe A; the water or other fluid to be raised enters by the branch pipe B; and the overflow is formed by the branch pipe C, cast on the lower part of the apparatus, as also the flange D, which flange forms the connection to the boiler or other receiver through which the fluid to be injected passes. The steam nozzle E, is screwed into one end of the adjustable cylinder F, and is surrounded by an envelope or casing G, leaving a free space between the outside of the nozzle E, and its casing G; this space may be filled with any non-conducting substance, or it may only contain the air enclosed in putting on the casing. The object of surrounding the steam nozzle with any non-conductor of heat, is to maintain a high temperature of the steam until it reaches the exit from its nozzle E, as priming is very injurious whilst forming the vacuum. The water or second nozzle H, in this modification is extended to a considerable distance beyond the first or steam nozzle E, and becomes of an annular form by the introduction of the centre adjustable spindle I. This spindle I, by reason of its tapered form, when raised or lowered by turning the hand wheel J, increases or diminishes the annular space, to suit the pressure of steam employed, and the height from which the water or other fluid has to be raised. At a short distance from the aforesaid nozzle H, a receiving nozzle or throat K, is so placed and adjusted by means of a self-acting valve L, that when a greater or less quantity of fluid is discharged from the second nozzle H, the throat accomodates itself accordingly. The adjustable cylinder F, may be raised or lowered by turning the hand wheel M, through the introduction of a screw formed on itself, working in a nut formed in the upper part of the apparatus, as shown at N, or any other convenient appliance to obtain a similar effect—that is the raising and lowering of the cylinder to suit the desired quantity of fluid to be injected. A series of holes or slots is formed opposite the steam branch A, through which the steam passes to the interior of the cylinder F, as indicated by the arrow at O. To maintain a perfectly air-tight packing between the steam-branch A, and the nozzle chamber P, hemp or other elastic substance is forced into the space Q, between the adjustable cylinder F, and the body of the apparatus, by means of a gland R; the cylindrical part of which, within the body of the apparatus, and where it passes the steam branch A, has a series of holes or slots to admit of a free passage of the steam to the interior of the adjustable cylinder F. When water or other liquid has to be raised about 20 or 25 feet, it is very necessary that the lower packing Q, should be perfectly air-tight, and this can be accomplished at any time by screwing up the gland R. To prevent any passage or leak of steam within and around the gland R, two small stuffing boxes with glands S, and T, at right angles to each other, are screwed up by means of bolts or studs when required. The adjustable spindle I, is kept steam-tight by the stuffing-box U.

The action of the apparatus may be described as follows:—On steam being admitted by the branch pipe A, it issues at the nozzle E, and on meeting the angle of the second nozzle H, it is deflected towards the centre spindle I, which again deflects it towards the nozzle H, in a zig-zag form, as indicated by the dotted lines. This zig-zag wave motion expels the air from the nozzle chamber P; and the steam, forming, as it were, an annular fluid piston, prevents any return through the nozzle H. So soon as the vacuum is sufficient to raise the water or other fluid to be injected, it rushes in through the branch pipe B, and is expelled by the steam through the second nozzle H, the water and steam together now forming the fluid



*From *Newton's Journal of Art.*

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piston in the nozzle H. The water as yet may not have sufficient force to pass through the throat K; it therefore gets an outlet by the overflow passage C. On turning the hand wheels J, and M, so as to give both more water and steam, the force imparted to the water becomes sufficient to pass through the throat K, and enter the boiler or other receiver. In starting the apparatus, it is essential that the steam nozzle E, should be close to the second nozzle H, when the water has to be raised from a great depth, such as 25 feet, but otherwise the setting or adjusting of the apparatus is very similar to those now in use.

A modification of packing the adjustable cylinder F, is represented in fig. 2. In this arrangement one gland E, serves to screw up both the packings Q, and Q¹, and by merely using a loose ring or cylinder between the two packings, one gland E, serves to maintain the adjustable cylinder F, perfectly steam and air-tight. Around the loose ring or cylinder V, and through it, are a series of holes or slots opposite the steam branch A, to admit of the steam passing to the interior of the adjustable cylinder; in other respects this modification is similar to that already described. Instead of admitting the steam by the branch pipe A, and the water by the branch pipe B, they may be reversed, as shown in fig. 3, where B, is the steam branch, and A, the water branch. In this modification the steam for the first impulse strikes against the centre spindle I, and is deflected towards the nozzle H, as shown by the dotted lines; otherwise the action and construction of the apparatus are similar to those just described. The water passing through the nozzle E, is expelled through the nozzle H, by the surrounding ring of steam, and gains sufficient force to pass through the throat K, into the receiver, where water or other fluids are required.

It will be observed, from the foregoing description, that water may be raised from a great depth and fed into a steam boiler or other receiver direct by the afore-mentioned apparatus.

At fig. 4 is shown, in vertical section, another modification of the improved apparatus for injecting or ejecting fluids, which arrangement is considered to be one of the most important features of the invention. The outer casing of the instrument has formed on it two water branches A, and A¹, and one steam branch B. Immediately on the inside of this outer casing there is fitted the gland C, which presses upon the packing D, this pressure being continued further on to the next ring of packing D¹, by the introduction of the slotted metallic cellar E, the slots formed in which are for the purpose of enabling the water admitted through or at the branch A, to be carried in towards the central part of the instrument. Beneath the second ring of packing D¹, there is placed another similarly formed metallic ring E¹, with slots also formed in it, to enable the steam to be condensed into the annular steam space F, of the apparatus, and this in turn acts or presses upon the lowest ring of packing D², the several rings of packing D, D¹, and D², forming a suitable bed, in which the barrel G, is capable of sliding, to be adjusted as may be required. The barrel G, it will be observed, forms the outer shell of the annular steam space. Inside the barrel G, is fitted the gland H, bearing upon the ring of packing I; this again bears upon the slotted metallic ring J, below which is situated another ring of packing I¹. These two rings of packing I and I¹, forms suitable beds, within which the barrel K, forming the inner annular water space L, is capable of being adjusted with respect to the barrel G. Inside the barrel K, there is situated the adjustable spindle M. Both the spindle M, and the barrel K, are actuated by the hand wheels N, and N¹, in a similar way to that described in reference to figs. 1 and 2. On more particularly referring to fig. 4, it will be observed that both of the barrels G, and K, are mounted at their lower ends with nozzles O, and O¹, within which is contained the non-conducting substance, or it may be an air-tight space, shown in black.

It has been mentioned that there are two water inlets or branches A, and A¹, in this arrangement, in lieu of one; whilst there is only one inlet for steam. These two water branches A, and A¹, are in direct communication with the two annular nozzles. When it is desired to feed a fluid of a somewhat elevated temperature, the warmed fluid is admitted through the branch A, whence it travels or passes onwards to the central water space L; but since the principle of the apparatus, and its effectual working, are chiefly dependent upon the formation of a vacuum produced by the condensation of steam admitted at the branch B, it is obvious that if the injected or ejected fluid be of a very elevated temperature, it will act detrimentally upon the working of the instrument by preventing so perfect a vacuum from being formed. To counteract the production of this effect, and to secure the very effectual working of the instrument prior to the admission of the heated fluid, a colder fluid, or one possessed of a temperature sufficiently low to ensure the action being effective, is first admitted through the branch A¹, and this coming in contact with the steam jet, causes the latter to be speedily condensed; when the cold water is impelled forward with a velocity corresponding to that of the pressure of steam used, rushing from an orifice into the atmosphere—the impelled water having a momentum equivalent to its own weight multiplied by the velocity of the flow of the steam or other impelling fluid. So soon as the action of the instrument is insured by the admission of the cold water and steam, then the heated liquid is admitted, and it is, as it were, pulled forward through the nozzle by the rushing action of the colder fluid.

A slight but important modification of this last-described apparatus may be effected by forming it without the water branch A, and substituting in lieu of it a port or duct C¹, shown in dotted lines extending upwards on the exterior portion of the instrument in direct connection with a passage or communication with the slotted rings E, and J, through which the fluid passes into the inner water space of the instrument. It must be borne in mind that when the instrument is formed in this last-mentioned manner, it is to be used for injecting or ejecting a fluid of a comparatively low temperature, in which case there will be formed at the nozzle two annular jets of the injected or ejected fluid, with an annular jet of steam situated concentrically between them, or, instead of this, two jets of steam with a jet of water intervening; and these arrangements effect a much more perfect condensation of the steam than when only a single jet of water is employed, as in the former modification, thus producing a more perfect action of the instrument. It will be observed that the central spindle is extended, so as to diminish the area of the injecting nozzle H. The screw U is for the purpose of adjusting the position of the outer barrel K. This screw is capable of revolving easily in the upper part of the outer casing of the instrument; the screwed portion of it fits into a corresponding hole in the bracket formed on the side of the barrel K, and it is actuated by means of a winch handle or screw key made to fit on its upper end.

Another form of injecting or ejecting apparatus is shown in vertical section at fig. 5, which consists simply of an outer casing A, into which a current of cold water or other fluid of low temperature is admitted by the branch B, and out of which it flows by the duct C. The use of these two branches B, and C, is to provide a continuous flow of cold fluid around the conical nozzle D, into which steam is admitted and condensed. When the condensation has taken place, a continuous rush of steam from the source of that fluid impinges upon the condensed portion, and causes it to emitted from the nozzle with a momentum corresponding to the amount of condensed steam multiplied into the velocity with which the steam itself would rush into a vacuum.

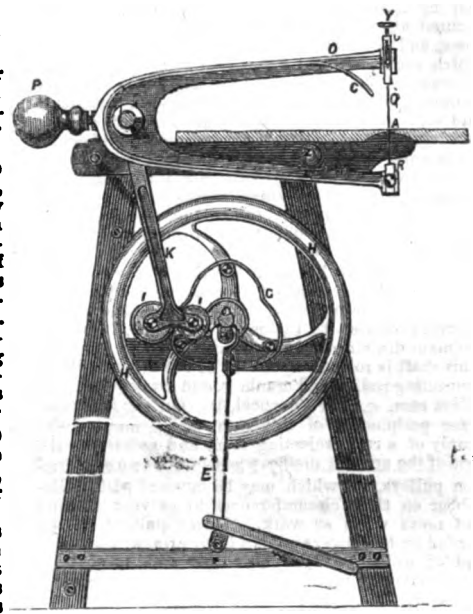
Fig. 6 is a modification of this last-named apparatus, in which the whole or a portion of the condensing fluid is ejected, as well as the condensed fluid itself; this result being effected by making the nozzle to terminate a short distance within the vessel containing the condensing fluid.

The patentee claims, "First—the general construction and arrangement of apparatus with an extended annular nozzle or nozzles for raising and forcing fluids generally, as described. Second,—the extension of the central spindle of the instrument into the injecting nozzle, so as to form an annular space therein, as well as to enlarge or diminish the area of that space in the manner described. Third,—the use and application of an extended annular nozzle for raising and forcing water or other liquid into steam boilers direct, as described. Fourth,—The use of a fixed casing containing any non-conducting substance between the steam and water nozzles, for the purpose and in the manner described. Fifth,—the use of an adjustable air-tight packing between the steam and water inlets, as hereinbefore described. Sixth,—the general arrangement and construction of apparatus for injecting or ejecting fluids, in which two barrels are employed to form annular jets of water and steam, which may be either two jets of water with a jet of steam between them, or two jets of steam with a jet of water intervening, as described. Seventh,—the arrangement and construction of apparatus for either injecting or ejecting a fluid of elevated temperature in combination with a colder fluid, as described. Eighth,—the system or mode of injecting or ejecting fluids of different temperatures in immediate contact with the steam nozzle, as described. Ninth,—the arrangement and construction of apparatus for injecting and ejecting the condensed fluid without its being in contact with the condensing fluid, as described."

CUTTING SCROLLS, FRETS, &c.

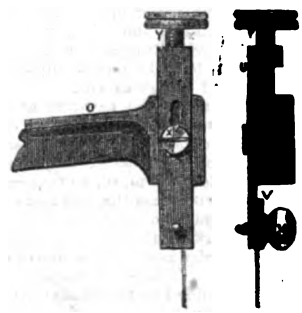
JAMES KENNAN, *Dublin—Patent dated April* 11, 1865.

This invention, recently published in the *Practical Mechanic's Journal*, relates to a peculiar combination of machinery or apparatus for cutting scrolls, frets, or filagree work in wood, metal, or other materials capable of being so cut, and consists essentially in the employment for that purpose of a vibrating or oscillating frame, in which a fret saw is strained, such frame deriving its motion direct from a cam having two or more inclines or actuating surfaces on the first motion shaft, which may be worked by a foot lever or otherwise.



According to one mode of carrying out this invention in practice, a pair of standards of any convenient form support a table upon which the material to be cut is laid. Beneath this table there is a crank shaft, provided with a fly-wheel, and carrying also a cam, having two, three, or more inclines formed thereon, according to the number of vibrations required in the saw frame at each revolution of the shaft. This shaft may be driven by a foot lever or treadle, connected with the crank by an ordinary connecting rod. Above the table there is fitted a rocking shaft, working in ordinary bearings, and to brackets on the upper and under side of this shaft are fitted two arms, the one being above and the other below the table. Or these arms may both be

FIG. 2. FIG. 3.



cast in one piece, which arrangement is preferred. Between the free ends of these arms is strained the fret saw, by means of a nut and screw, or other convenient contrivance. One of the various modes which may be adopted for straining the saw consists in passing a short steel spindle vertically through the free end of one or both of the vibrating arms, and to make one end of this spindle (which is split to receive the end of the saw blade) conical, with a

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screw thread on such conical part. By screwing a nut along the conical screwed portion of the spindle, the saw blade will be tightly grasped and held within the split. The other end of the spindle is also screwed, but the screwed part has two flat faces filed thereon, to permit the screw rising through a washer or collar on the vibrating arm, and at the same time prevents it from rotating therein, the hole in the washer being of a shape to correspond to the flattened form of the screwed part of the spindle. A hand nut is screwed on to the end of the spindle, so that by tightening up this nut the saw may be strained to any desired extent. A more simple mode consists in screwing one end of the saw by a pinching screw to the end of one of the vibrating arms, whilst the other end of the saw is screwed, by a pinching screw, to a slide working in a vertical groove in the end of the other arm, such slide being acted upon by a set or adjusting screw, whereby the straining of the saw blade may be readily and simply accomplished.

Motion is imparted to the rocking shaft arm and saw by means of another arm or lever, which is secured at one end to the rocking shaft, whilst its lower end carries one or a pair of anti-friction rollers, which are actuated by the cam on the crank shaft before referred to. The rocking shaft, and the three vibrating arms in connection therewith, constitute one arrangement of vibrating or oscillating frame, receiving its motion direct from a cam; but of course these parts may be otherwise disposed without departing from the essential feature of the invention.

Fig. 1 of the engravings represents a sectional elevation of the improved fret cutting machines. The other two figures are details afterwards more particularly referred to.

A is the standard or main framing of the machine, which may be of wood or of ornamental iron work, which latter is preferred. B represents one of two bearings carried by the main standards, in which the main drawing shaft, C, of the machine revolves. This shaft is rotated by means of the foot treadle D, connecting rod, E, and crank, F, and carries the triple action cam, G, and fly-wheel, H. On the inner and outer peripheries of this cam, which may consist simply of a run projecting from and secured to the side of the arms of the fly-wheel, work two anti-friction pulleys, I I, which may be covered with india-rubber on their circumferences to prevent shaving and noise when at work. These pulleys, I, are carried by the lower end of a lever arm, K, the upper end of which is keyed on to the rocking shaft, L, which vibrates in bearings, M, secured to the table of the machine. O O′, are two arms, which it is preferred to cast in one piece of a ⊂ form, and which are also keyed into the rocking or vibrating shaft, L. The overhanging portions of the arms, O O′, are balanced by the counterweight, P, and the saw blade, Q, is strained between the two vibrating ends of the ⊂ shaped lever, as is clearly shown in figs. 1 and 3. Enlarged side and front elevations of the arrangement for straining the saw are represented respectively at figs. 2 and 3. The end of the saw blade having been passed down through a hole or slit, *a*, in the table, is nipped and held firmly between the side of the plate, R, screwed to the end of the arm, O′, and the small plate or washer, S, by means of the pinching screw, T, whilst its upper end is similarly nipped between the adjustable vertical slide, U, and the plate or washer, V, by the pinching screw, W. This slide, U, is held in a slot in the side of the arm, O, by the pinching screw, X, which passes through a slot, *b*, in the slide. Y is the tightening or straining screw; it works through the end of the slide, U, and bears against the top of the vibrating arm, so that on turning this screw the slide will be drawn upwards, and the saw blade strained to any extent.

In order to blow away the sawdust at each upward stroke of the saw, it is proposed to employ a self-inflating india-rubber ball, Z, or other simple form of bellows, which is placed underneath the table, and above the lower arm, O′, so that each time this arm rises it will compress the ball and expel the air therefrom, which air is directed by the tube, *c*, to the surface of the work at the point where the saw is operating, and thereby keeping the line of cut constantly clear to view The work to be cut is laid upon the table, and guided by the hands of the operator, whilst the foot actuates the treadle, and so gives motion to the saw. By making two or more acting surfaces on the cam, G, any number of vibrations of the saw per revolution of the main shaft may be obtained.

TIN wire, the thirteenth of an inch in thickness, sustains 34·7lb., a lead wire but 28lb.

THE first pendulum clock was made in 1641, for t. Paul's, Covent-garden.

DUMAS' LAMP FOR THE USE OF MINES.

By M. BREGUET.*

THE apparatus called Dumas' lamp utilises the light produced in a vacuum by the passage of currents of induction; it consists, then, in a necessary manner, of a battery, an induction apparatus, and a vacuum tube, called a Geissler tube, from the German manufacturer who made the first.

The battery furnishes a quantity current; this inducing current produces in the induction apparatus an induced current or one of tension; and, finally, this induced current, traversing the vacuum tube, produces there a light sufficient for conducting one in darkness, for reading characters traced on paper, or even divisions engraved on an instrument, finally for working in a mine.

The battery is of two liquids; in the interior of the porous cell is a piece of carbon, which forms the positive pole of the battery, and which is immersed in water, acidulated with sulphuric acid, marking 16 deg. on the hydrometer (for acids), to which is added pulverised red bichromate of potash. At the exterior of the porous cell is a cylinder of amalgamated zinc, forming the negative electrode of the battery, immersed in a solution of sulphuric acid to 6 deg. of the hydrometer. The cylinder of zinc has a diameter but little different from the porous cell, so that the distance between the electrodes should be as little as possible, and, consequently, that the resistance is as small as possible. The exterior case of the battery is a bag of india-rubber, at the bottom of which is placed a round piece of amalgamated zinc, which increases the surface of the negative electrode, and serves as well to support the india-rubber bag, as to protect the porous cell against any shock or shake.

The upper part of the battery is closed in a manner completely hermetic by a plate of hardened india-rubber, kept in its place by screws. Two small tubes of india-rubber, communicating one with the interior and the other with the exterior of the porous cell, give exit to the gases which are formed by the working of the battery.

The battery thus composed can give a constant light during twelve hours, at the least; but if it is not kept at work, it is preserved much longer, and can give light at the end of a week.

The expense of maintenance of this battery may be valued at one cent per hour of effective working, or 1d. for a day of ten hours; and this expense being the only one which the use of the Dumas' lamp requires, it is seen that this apparatus costs less than a Davy lamp.

The inductive apparatus does not differ essentially from apparatus of this sort employed in laboratories.

Around a centre, composed of iron wires well annealed, are wound two layers of a primary wire, called the "inductor," of a sufficiently large diameter, through which passes the battery current. Around this "inductor" is wound the induced wire, of which the diameter is much less, and of which the spires and the different layers are insulated one from the other with the greatest care. The induction circuit is provided with an automatic trembler, which interrupts the induction current, and re-establishes it with great rapidity.

The two extremities of the induction wire are placed in communication with the two metallic faces of a Fizeau condenser, the action of which upon the luminous effects of the induction apparatus is very important. To each of the making or breaking of the induction current corresponds an induced current of the fine wire of the coil, and sent into the luminous tube.

The luminous tube is a tube of glass in which a vacuum has been made after having filled it with azote or nitrogen, so that it still contains very rarefied azote. This tube is sealed to the lamp, so that it preserves its vacuum indefinitely. It shows a central chamber in which are placed two rather fine tubes, one of which has circumlocutions spread out in the same plane, which have the effect of multiplying the lighting surface, and of consequently augmenting the light.

These fine tubes are made of glass or uranium, whose fluorescent properties render more constant the light from the current of induction, which, in fact, is intermittent, although it is impossible for the eye to distinguish the intermittence. This vacuum tube, which already is of a sufficiently great thickness, is protected by a very thick exterior tube, the solidity of which is very great. The exterior tube can be surrounded with a special reflector, half cylindrical, which throws the light forward that would otherwise be lost.

A turning commutator placed above the battery allows one to close or open the induction circuit, and, consequently, to make the light appear or disappear. The battery and induction apparatus are enclosed in a box of leather and in wood, furnished with a cover closed with screws with hardened india-rubber nuts. The commutator alone projects a nut or button in hardened india-rubber above the before-mentioned cover.

The box is supplied with a leather band, which enables the apparatus to be carried in a shoulder belt. The tube is attached to this box by conductors, seventy-five centimetres in length, carefully insulated with cotters, first a tube of india-rubber, then a second tube of india-rubber sufficiently thick, which gives a great resistance and a certain thickness to these cords. By aid of these conductors the tube held in the hand can be passed by the bearer all round him, while the box which furnishes the current rests immoveable on his back, or on any support whatever.

For facility of transport the tube has also a place made on the side of the box, in which it is sustained by leather bands of such a sort that even in this position it can lighten the path of the person who carries the instrument, especially if he is supplied with the reflector of which we have spoken. In the box itself the wires which place in communication the battery and the induction apparatus, are insulated with the same care as the external conductors, terminating in the luminous tube; finally the induction apparatus enclosed in a small wooden box is placed in a double envelope of sufficiently thick india-rubber.

All these envelopes have the accessory advantage of decreasing the shocks the apparatus might receive; but their principal object is to prevent an electric spark from passing between the conductors, and firing the explosive mixture of gas in which the apparatus might be placed, which would produce the greatest danger. Everybody who sees the Dumas' lamp perceives at first sight that this danger is completely averted.

It is known that in mines it frequently happens that the gases which escape from the sides form, with the air, explosive mixtures. The introduction of an ordinary light in a mine where these phenomena are produced might cause the most frightful accidents, in producing the explosion of the gaseous mixtures of which we have just spoken. It is under these circumstances that the use of safety lamps becomes necessary.

Amongst the most used and most useful of the safety lamps is that of Davy, which might be taken as a type. The Davy lamp has several great defects—first, it may be opened by the workman who carries it, and who, when wishing to obtain a more brilliant light, would let it burn without the surrounding protection of metallic net; it might be extinguished if, as is often the case, water should fall upon it from the roof of the gallery; placed in an impure atmosphere it fails and sometimes suddenly goes out, leaving the workmen without light. Moreover, in cases were light is necessary in order to prevent danger, it may happen that one has men to save—urgent works to execute in an atmosphere where life is possible at least for a short time, and where the Davy lamp cannot burn. In such cases the Dumas' lamp would be often of an inappreciable value, for it burns as well in a gas absolutely unfit for combustion and for respiration, under water, and in all the conditions where ordinary combustion lamps are either dangerous or unable to give light.

It will be remarked that there is no possibility of explosion of inflammatory gases from the spark of induction, for it only passes in vacuum (at least from the distance where the two platinum points are placed, which are sealed at the two ends of the vacuum tube); and if by accident the vacuum tube should be broken the air would enter the vacuum and immediately all light and all passage of electricity would cease.

It is known that electric currents have been used for a long time to explode powder and to blast mines. Such has been up to this time the only industrial application of the induction apparatus. The Dumas' lamp offers two means of arriving at this result. The first consists in employing the intermediary of the induction apparatus; one has only to suppress the communication between the induced wire and the luminous tube, and to attach it to the insulated metallic conductors which are attached to a Statham or Abel fuse, in which two metallic points, placed at a short distance from each other, and surrounded with sulphuret of copper, and of a small quantity of fulminate of mercury, then ordinary powder, letting escape the spark of induction and lighting the powder.

The second means employs directly the battery; it is sufficient to send the current of the battery in a

* Read before the Manchester Geological Society.

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fuse specially composed as follows:—A very small platinum wire, attached to the ends of two wires which come from the battery; this platinum wire is surrounded with gun cotton first and ordinary gunpowder afterwards, enclosed and held in a small gutta-percha bag. When the current passes this the platinum wire reddens and ignites the gun cotton, which sets fire in the gunpowder used in the mine. This second means is, according to M. Dumas', the surest and most convenient.

REVIEW.

A Treatise on Gas Works, and the Practice of Manufacturing and Distributing Coal Gas. By SAMUEL HUGHES, C.E.; Revised by W. RICHARDS, C.E. London: Virtue, 1, Amen Corner, Paternoster Row.

Those of our acquaintance who are in possession of the first edition of this work have always expressed satisfaction therewith; to those of our readers who are not in possession of the work we can recommend this, the second edition of the work, as being all—and a great deal more—than it pretends to be. For the merely general reader there is a great deal of interesting matter—the man who desires to know the "why and the wherefore" of all connected with gas works and gas making, with its distribution to the humblest single fish-tail, will find what he requires, set forth in a most attractive form, and illustrated in every essential particular, in some instances lavishly.

Respecting the first patent in the matter of gas-lighting we have it here set forth that—

"In 1804 Mr. Winsor obtained a patent for an improved oven, stove, or apparatus, for the purpose of extracting inflammable air, oil, pitch, tar, and acids, from, and reducing into coke and charcoal, all kinds of fuel, which is also applicable to various other useful purposes.

"A metal brick, or earthen stove, oven, retort, or vessel, is so constructed to reduce by means of fire and heat all raw fuel of any kind into coke and charcoal, without any, or little, consumption of the fuel, by which operation the smoke being extracted from all raw fuel, is thus conducted through cold air or water into a condenser, where, after being sufficiently cooled and purified, it undergoes a natural chemical resolution into tar, pitch, oil acid, ammonia, and inflammable gas or air.

"The inflammable gas or air may be led in a cold state through tubes of silk, paper, earth, wood, or metal, to any distance, in houses, rooms, gardens, places, parks, and streets (and other places), to produce light and heat, or for any other purpose, such as for increasing and multiplying force and power."

Going on to the struggles of Mr Winsor, and the formation of the first company in London, we find the following:—

"Having this patent, Mr. Winsor describes himself as the discoverer, inventor, and patentee of gas-lighting, and agitated the necessity of forming a company for its full development, so that the streets, shops, and private dwellings should enjoy its advantages; but gas-lighting, like every other great innovation, was looked upon by the public with excessive distrust. In the event of its success, several branches of industry and commerce were doomed to suffer; many interests were, or supposed to be, at stake; some of the chemical properties of gas were unknown; great doubt existed as to its safety, and fears as to its salubrity; indeed, the danger of explosion was magnified to the extent that it was asserted, and believed, that a town could be destroyed by the explosion of the main pipes in the street; and interested parties, in order to prevent the establishment of gas-lighting, did not scruple, to appeal to the naval glory of the nation, and this shortly after Nelson had achieved his great victories. 'If,' said the opponents of the new light—'if this becomes successful, then our naval supremacy is gone, for at present we obtain principally our artificial light from the whale fisheries: these are the nurseries of our best sailors: so if we destroy the one, the other must be affected; if the fisheries no longer exist, our navy must degenerate.'

"These objections and arguments were put forth frequently by the journals; and Mr. Winsor, who by this time had become intimately associated with gas-lighting, and in a manner constituted himself its champion, met them with that extraordinary courage, perseverance, and zeal which so strongly characterised him; but it is to be regretted that although a gentleman of superior intelligence—with the great qualities already awarded him—he lacked the scientific knowledge so essential for the fulfilment of his undertaking, and unfortunately he was not aware of this deficiency. He boldly combatted all possible objections with unexampled ardour, but often committed the most egregious errors, at one time asserting that our atmosphere in its pure state was too powerful a medicine, and that a mixture of coal-gas rendered it more salubrious; again, that gas would not explode when intermixed with air, and that its adoption would purify the atmosphere; whilst the prospectus issued by him contained most extraordinary, exaggerated, and fabulous accounts of the enormous profits to be derived from gas-lighting. All this combined to retard his progress, and had he been of a less sanguine nature, his task would have been comparatively easy. These errors often brought down upon him the greatest ridicule, in which some of the leading scientific journals took prominent part; but, undaunted, he still persevered.

"At length, after having struggled, during four years, single-handed, and, as it were, against the opinion of the world—having by his letters, pamphlets, lectures, &c, proved the advantages of gas—Mr. Winsor succeeded in 1807 in obtaining a capital of £20,000 by means of subscribers, preliminary to the formation of a company; which sum was intended to demonstrate the practicability of manufacturing and supplying gas on a large scale; also for the purpose of forming the company, and obtaining a Royal charter.

"Mr. Winsor then occupied extensive premises in Pall Mall, on the site of the present Carlton Club. On the basement he had gas manufacturing and other apparatus to illustrate his lectures, demonstrating the practical utility of gas for lighting, heating, and cooking, also its safety and salubrity; the public, on certain days, having free access to take cognisance of the process. From these premises a pipe was laid in Pall Mall to the corner of St. James's Street westward, and to the Haymarket eastward, with lamp-posts at short intervals, including several in front of Carlton House, the residence of the Prince Regent; and thus Pall Mall was the first street ever lighted by gas, and continued so during the sessions of parliament of 1809 and 1810, whilst endeavouring to obtain an Act of incorporation and charter.

The intention of Mr. Winsor, and his subscribers or shareholders, in 1808, was to establish a company, and obtain a Royal charter of exclusive privilege for lighting all the British possessions by gas; and for this purpose they proposed a capital of one million sterling.* A memorial was accordingly presented to the King, setting forth the advantages which would result from gas-ligthing, and the production and general employment of coke, praying for the concession; but after the question had been duly considered in Privy Council, it was decided that his Majesty could not grant the charter of incorporation until a Bill had been obtained from parliament authorising the company.

"The following year Mr. Winsor and his shareholders again applied, with more modern pretensions, to be established at the 'National Light and Heat Company,' but were strongly opposed by Mr. Murdoch; and on this occasion many scientific witnesses were examined before a committee of the House of Commons, who proved incontestably that gentleman's claim to priority of adopting gas for illumination. The evidence given is of the greatest interest; but the errors of a leading witness for the company, and the merits of Mr. Murdock, caused the application to be refused.

"Amongst Mr. Winsor's subscribers were some eminent men of the day, and, like himself, of the greatest perseverance and zeal. They had already been too familiar with difficulties to be discouraged by defeat; and again, in 1810, they applied to Parliament, and succeeded in obtaining an Act of incorporation as the 'Gas-light and Coke Company,' with a capital of £200,000. But the enterprise was looked upon as so visionary, that it was asserted this Act was granted in order to make a great experiment of a plan of such extraordinary novelty.

"The royal charter was granted to the company in 1812; but the privileges accorded by that charter were neither liberal nor encouraging; for by it the company had no exclusive right, so as to prevent any other persons or company from entering into competition with them. The power and authority granted were very moderate; and whilst the company were under severe restrictions, they were confined to the metropolis, and were liable to have the charter annulled if they failed to fulfil their obligation."

From thence we travel on through the various companies, the various methods of making and purifying gas, and all about the necessary buildings, "tools," and "chemicals." Coming to the chapter on retorts, we find a little bit which will doubtless be of interest to many of our readers. It is on the cement employed in attaching the mouth-pieces to iron retorts, &c., but as it is obviously suitable to many other joints we extract the matter entire.

"The recipes for making iron cement vary considerably. Mr. Peckstone says 1lb. of iron borings or turning are to be pounded in a mortar into a state of fine dust or powder; these are to be mixed with 2 oz. of sal ammoniac in powder and 1 oz. of flour of sulphur; the whole to be thoroughly incorporated by being pounded in a mortar. When required for use, take one part by measure of the above compound, and mix it with twenty parts of pounded iron borings, adding water to bring the mixture to the consistence of ordinary mortar. This cement may be applied in making all sorts of flange joints, as in securing the mouth-pieces to the retorts, the dip-pipes to the hydraulic main, &c.

"Mr. Clegg's recipe is somewhat different: he uses

Iron borings or turnings...	32 oz.
Sal ammoniac	1 ,,
Flour of sulphur...	1 ,,

To be well mixed together, and kept dry for use. When required, water to be added to bring the mixture to a proper consistency.

"The French employ the same purpose a cement called the Mastic d'Aquin, which is thus prepared:—

98 parts of clean iron turnings, pounded and passed through a sieve.
1 part of flour of sulphur.
1 part of sal ammoniac, dissolved in sufficient boiling water to bring the whole mass to the consistency of ordinary mortar.

This cement is not prepared till required for use, and should be employed as soon as possible. The iron borings should be sifted, and perfectly free from grease or oil, otherwise if too granulated or greasy a good joint cannot be made."

(*To be continued.*)

* French translation of Accum of Gas, by F. A Winsor.

GENERAL NOTES.

IN Wales, at the old Clogan copper mine, the quartz yields about 1oz. of gold to the ton. At Castell Carn Cochan 5 oz. 12 dwts. of gold were obtained from 20 cwt. of quartz from the lode and from alluvial matter.

SINCE the Russian Government gave up the working of the gold mines in the Ural Mountains, and arranged for them to be worked by private enterprise, the quantity of metal extracted has been increased tenfold.

Two iron plates 4ft. in diameter, and weighing 1,000 lb. revolved 80 times in a minute, send sufficient heat up a furnace to warm a large factory. They are turned by a band and water wheel, and last for years.

PROFESSOR TYNDALL has succeeded in entirely cutting off the luminous from the calorific rays, and to produce not only combustion in an absolutely dark focus, but also the incandescence of platinum by non-luminous rays.

ACCORDING to the theory of the late Mr. Taylor, the granite coffer in the Great Pyramid was a primeval measure of capacity from whence is derived our wheat measure the "quarter," of which coffer it is the fourth part exactly.

MANUFACTURE OF OXYGEN GAS.—Messrs. Parker and Tadner, of Birmingham, propose to manufacture oxygen gas by heating a mixture of nitrate of soda and quick lime. They obtain as by-products caustic soda, and a compost consisting of lime and nitrate of lime.

PETROLEUM GAS ON RAILWAYS.—The London and North-Western Railway have had some of their carriages experimentally lighted with gas made from petroleum. The apparatus containing the gas occupies half the space under one seat, and the compartments were quite as brilliantly lighted as they would have been by ordinary coal gas.

EXHIBITIONS.—We are glad to say that, notwithstanding the Fenians, the Dublin Exhibition is a success. During the last ten weeks the provinces have come in, and saved the projectors from trouble.—The Bristol Industrial Exhibition produced £3,253 14s. 11d. Of this sum a portion is appropriated to prizes, the remainder goes to the medical and other charities of the city.

IRON SMELTING IN COLORADO.—According to the *Denver News*, the business of iron smelting may now be said to be fairly inaugurated in Colorado. It appears that the Belmont furnace is in operation near Denver, and is turning out two tons of pig iron per day. The ores used are pronounced by competent judges to be the best in the world, and are excelled in richness only by the Pilot Knob and Lake Superior ores; but possess an advantage over these in the fact that they can be easier and more economically worked. The supply of ore is deemed inexhaustible and is easily obtained.

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APPLICATION OF DIVING APPARATUS FOR MINING PURPOSES.

THE value of modern discoveries in connection with practical colliery operations has been completely proved within the p st few weeks at the Grove Pit, near Tenby, where the enterprising proprietor, Mr. C. R. Vickerman, has succeeded in effecting a considerable saving of time, and a large amount of money, by availing himself of the services of divers, with Heinke's apparatus for performing work of an entirely novel description. It appears that in the Grove Pit the main rod, 16 inches square, of the 80-inch pumping engine, broke short off about 20 feet from the surface, and upon the new main rod being fixed, and the engine set to work, it was found that the valves (which were now entirely out of reach, the water standing 26 feet in the pit) would not act —the breakage of the main rod letting the spindle fall through the clack and seating to the bottom of the pump. According to the old method of putting in a new lift, many weeks would have elapsed before the pit would have been in working order, whilst the divers enabled everything to be put right again in from six to eight hours. The Grove Pit is 15 feet in diameter, and 630 feet deep, and is considered to be one of the finest in South Wales. Now that the diving apparatus has been once applied in a pit, there is little doubt that it will frequently be used in connection with mining operations, it being unquestionable that in innumerable instances its use would be both advantageous and economic.

CRUSHING ORE.—Alexander W. Hall, of New York, claims enclosing the crushing wheels of a machine for crushing and pulverising ore or other materials by an air-tight cover, so combined with the pan in which the said wheels work as to form therewith an air-tight chamber, in which the crushed or pulverised material is subjected to the action of a blast or blasts of air.

PHOTOGRAPHY IN NATURAL COLOURS.—Let us see what the existence of such a photographic process would imply. There must be a sensitive surface capable of assuming all hues This in itself it would not be easy to find. But more than this: each coloured light must cause the surface to assume its own exact tint. Now in the case of a single colour, say green, it seems to me that this could only be a coincidence. It would be as reasonable to suppose that a green substance—a green wax candle —should burn with a green light, as to suppose that a green light should produce a green substance. Of course it might do so; but there is no reason for believing in any necessary connection. At this rate photography in natural colours would require an infinite number of coincidences. But I would go further. Granting that the process were discovered, I say it would be impossible to work it. For since the surface is by supposition sensitive to light of all colours, it must be prepared and finished in absolute darkness. Now I have no hesitation in saying that if the new process were as delicate as the present one (and it could scarcely fail to be infinitely more so), it would be impracticable to work it in darkness. The difficulty is evaded now by working in a yellow light, to which the film is not sensitive. Taking these considerations into account, I am not at all sanguine about photography in natural colours.—*Hon. J. W. Strutt.*

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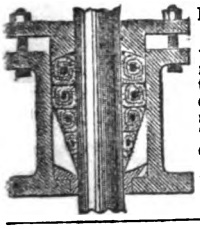

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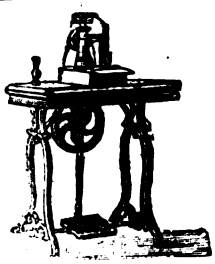

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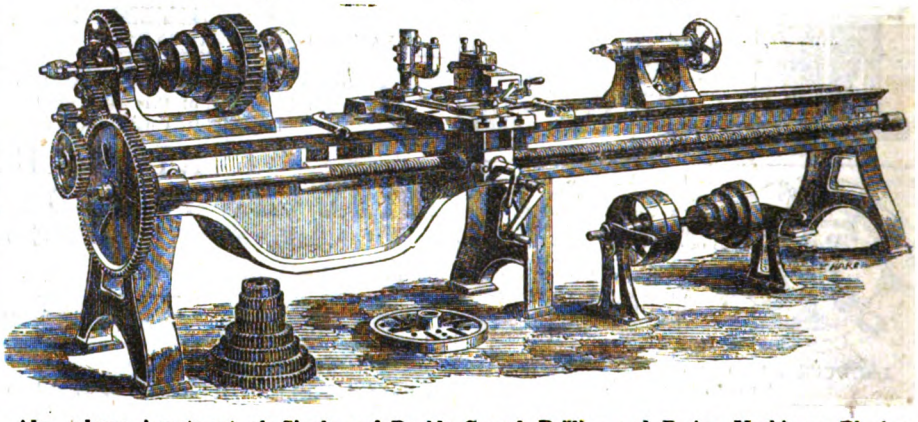

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THE

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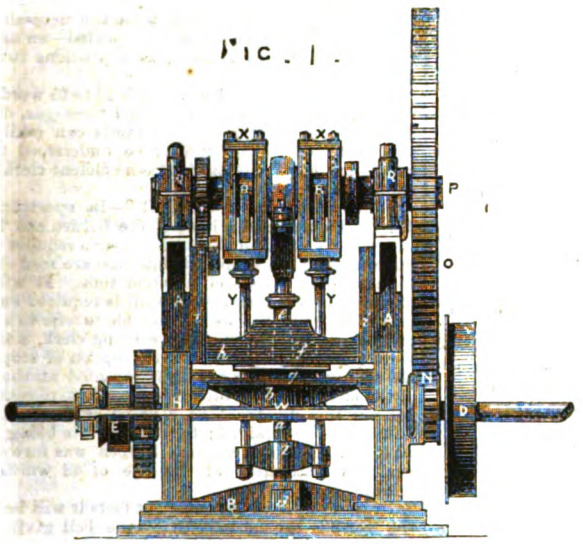
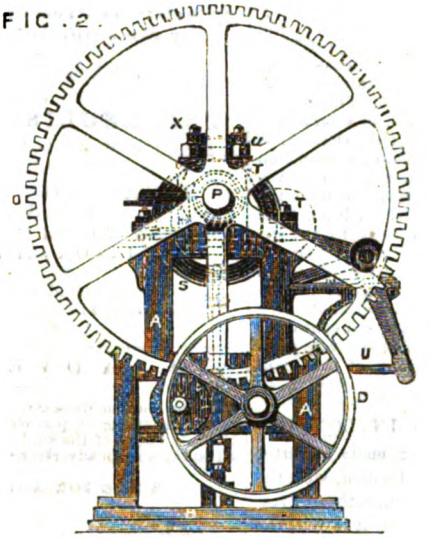
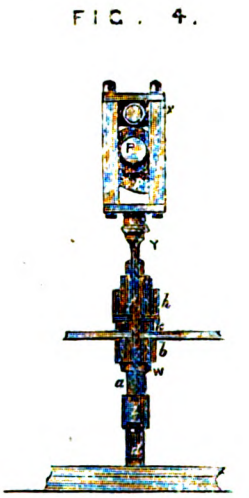
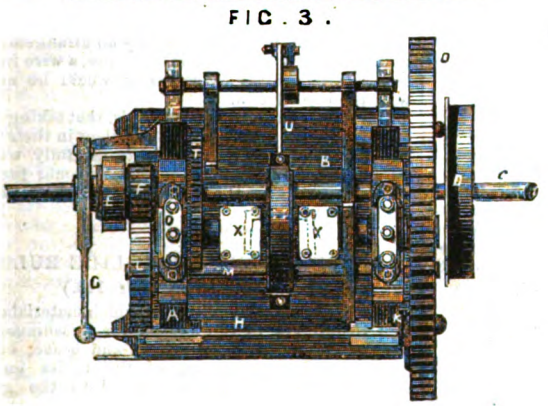
A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

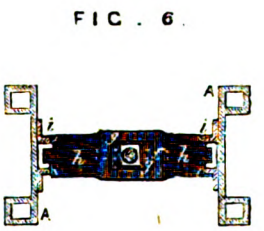
VOL. II.—No. 38.] FRIDAY, DECEMBER 15, 1865. [PRICE ONE PENNY.

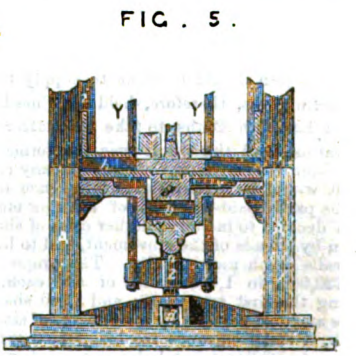












MANUFACTURE OF BRICKS.

IT has been objected to machine-made bricks that they are often extremely faulty through distortion in firing caused by the expansion of air globules which have been formed in the mixing and treatment of the raw material in the preparatory stage; at various times efforts have been made to get rid of this admitted evil, and place machine-made bricks on a still better foundation than that they now enjoy. Among the last of the patents taken out for this, combined with other purposes, is that of Mr. H. Chamberlain, of Wakefield, who, however, simply states that his invention relates to machinery for the manufacture of compressed bricks from what is known as "granulated clay," whereby distinct and separate pressures are applied to the clay at each revolution of the main shaft. The general working of the machine is sufficiently described in detailing the various parts of the machine.

Fig. 1 is a front elevation of the machine; Fig. 2 a corresponding end elevation; Fig. 3 a plan corresponding to Fig. 1; Fig. 4 is a detail side elevation of the plungers or pistons and the cams for working the same; and Figs. 5 and 6 represent respectively a detail sectional elevation and plan of the pistons or plungers and parts in immediate connection therewith. A is the framing bolted to the bed B, and carries the main shaft C, which shaft is provided with a driving pulley D, and friction clutch E, which engages with the spur pinion F, loose upon the shaft. The clutch E is thrown into and out of gear by means of a lever G, and rod H, the latter having a screw thread formed upon it, and being worked by an internal screw thread in the boss of the hand wheel I, carried by the double bracket K, bolted to the framing. The pinion F gears into a spur wheel L, fast on the second motion shaft M, which carries a pinion N at its opposite end in gear with the large spur wheel O, keyed on to one end of the cam shaft P. This shaft is supported in bearings Q, bolted to the top of the standard A, and carries the two cams R R, for working the upper pistons (Fig. 4), as well as the eccentric S, for working the lower piston T T¹, are spur wheels for actuating the self-acting feeder U; V is a fixed table bolted to legs on the inner sides of the standards, and having moulds formed therein supplied with clay from a hopper by means of the usual feeder; W is a piston or plunger which forms the bottom of each mould, receiving a rising and falling motion from a pair of small cams R (Fig. 4), keyed on to the overhead shaft P. These cams each revolve within a frame X, to the lower end of which is connected the rod Y, secured by a nut to each extremity of the cross head Z, keyed on to the piston rod *a*. The upper end of this rod carries the piston W (Fig. 5), working inside the moulding box *b*, and its lower end when down rests upon a packing piece *d*, on the bed plate or foundation B; S is an eccentric keyed on the shaft P, between the snail cams R, the rod *e* of which is connected by a long cross pin *f*, with the upper piston *g*, working inside the main beam *h*, which slides up and down in vertical guides *i i*. The piston or plunger *g* serves to form the indentation of the brick when a solid brick is to be produced, or to form the perforations by being provided with suitable pins when perforated bricks are required; *k* is the hollow plunger connected to the main beam *h*, fitting accurately into the mould *b*, the piston *g* working through the centre of this hollow piston (Fig. 5). The cross pin *f* works in vertical slots in the main beam *h*, so that it can move up or down without imparting motion to the main beam *h*.

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To further explain the *modus operandi* of brick making by this machine, we may remark that, both the upper pistons *g* and *k*, with the beam *h*, being elevated, clay is fed into the mould, the lower piston W, being at that time in its lowest position. The beam *h*, with its hollow piston *k*, then commences to descend, the piston *k* resting upon the clay in the mould, whilst at the same time the lower piston W rises, and by compressing the clay against the upper pistons expels a considerable portion of the air from the particles of clay. Whilst this operation is going on the inner or pannel piston *g* continues to descend slightly, the main beam *h* and hollow piston *k* remaining at rest. The amount of this descent of the piston *g* depends of course upon the length of the slots in which its pin *f* works, and so soon as the pin *f* arrives at the bottom of such slots, the beam *h* and hollow piston *k* will be carried down still further into the mould. In the meantime the bottom piston W, has dropped sufficiently to find a support on the packing underneath the lower end of its rod, and thus as the upper pistons descend they will force the partially compressed brick downwards to the bottom of the mould, and as the bottom piston has by this time obtained a solid bearing, the final pressure is given to the clay by the action of the eccentric on the upper pistons as it passes its centre. The pannel piston *g* then commences to rise, and so soon as the connecting pin *f* reaches the top of its slots f_1, it carries up with it the main beam *h*, and hollow piston *k* clear of the mould. The bottom piston in the meantime rises until its surface is flush with the table, thereby expelling the compressed brick from the mould, which is then pushed away by the advance of the self-acting feeder when bringing the next supply of clay, the piston W descending again to the bottom of the mould in readiness to receive the next charge, when the operations are repeated. We may remark that the "novelty" in the invention is the giving three or more distinct and separate pressures to the clay at each revolution of the main shaft.

WORKING MEN'S HOUSES IN LONDON.

A praiseworthy effort is being made to erect small blocks of urban dwellings in London, with the financial co-operation of the working men themselves. The only remedy for overcrowding is, it is felt, the erection of a sufficient number of dwellings in place of those appropriated by railway companies; and as men of capital do not seem inclined to invest their money in this direction, it has been suggested that working men should combine to supply the means A meeting was, therefore, held on Tuesday night at the Lambeth Baths, to take the matter into consideration, and the result was the formation of a "London House Improvement Company (limited)." As it would be impossible to commence operations on the partly paid-up shares of working men, it has been decided to include another class of shares to be taken by friends of the movement, and to be paid up by calls much more rapidly. The proposed capital is £20,000, in 1,000 shares of £10 each, payable during the first two years; and 1,000 shares of the same amount, payable by instalments of sixpence per week, a small entrance fee being charged on each share. According to a tabular statement, with which we have been favoured, the houses will probably produce 10 per cent., although 8 per cent. has been estimated. At the end of the eighth year, while 5 per cent. has been paid to the shareholders, a considerable addition to that percentage may be expected, and double the number of houses can be built. Mr. Samuel Sharp architect, has, it appears, prepared plans, which it is said will avoid many objections made against ordinary model lodging-houses. It is proposed to erect separate blocks of buildings, each containing two shops and eight dwellings, the shops having two back rooms attached. Each flat will contain two dwellings, each dwelling consisting of a living room 14ft. square, two bedrooms and scullery, &c. Washhouses, drying-room, and rooms for working men who are employed at home, will be erected in the attic. The promoter of this novel scheme also intend ultimately to erect houses in the suburbs, for the same class of occupiers, who may purchase the same "when they retire from their labours" with the accumulated dividends of years. We commend the project to the notice of artisans employed in the building trades. The investment would certainly be a safe and, we believe, a profitable one. It will, however, be necessary for the promoters to appoint sub-committees to enlist the sympathies and support of working men, and so extend the usefulness of their proposal.

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OUR CHRISTMAS NUMBER.

IN announcing his intention to publish an enlarged Edition of THE ENGLISH MECHANIC as a Christmas Number, without any increase in price, the Proprietor respectfully submits that he thereby affords the many thousands of readers and numerous contributors an opportunity of each contributing a something as a Christmas Treat for his fellows—some little "trick of trade" (in the good and true sense of the word); some improvement in tools, anything, in fact, which may be of value to brother workmen, and will assist in the promotion of feelings of kindliness and good fellowship, which the season is so eminently calculated to call forth. The Editor will not fail on his part, and will be glad to find a hearty response to this challenge to do mutual good.

THE MECHANIC'S EXCHANGE.

We again call the attention of our readers to the scheme for a "Mechanics' Exchange," contained in our last number. Hundreds of letters have come to hand, all praising the scheme, and some suggesting improvements in it. If the scheme is to be carried out it must be done thoroughly, and we await the opinion of the majority of our subscribers.

The English Mechanic.

FRIDAY, DECEMBER 15TH, 1865.

OUR TELEGRAPHIC INSTRUMENTS.

IT has been deemed that the insertion of the following particulars, brief indeed, as to the merits of the principal telegraph instruments now in operation in this country—viz. the "Morse" and the "Bells," will prove interesting to some of our readers, and tend to draw forth the opinions of those who have worked the various instruments, and who are therefore perhaps best qualified to speak as to their capabilities.

Much has been said and written in favour of both systems by those parties interested, both commercially and scientifically, but the object now is to endeavour to explain the actual rate of working, correctness, and general efficiency of the above-mentioned instruments, and as the Morse was the first of the two systems introduced to any extent in this country, priority is here given to it.

The Morse is principally used by the Electric and International and the United Kingdom Telegraph Companies. The instruments used by the latter differ slightly in construction from those of the former. One wire is required for the transmission of the signals, which are received, embossed, or printed in ink on a narrow strip of paper, and thus preserved for reference. By this means additional accuracy is guaranteed, as the clerk, when an unintelligible word is received is enabled to re-examine the signals; thus dispensing with the necessity in many cases of having the word repeated—an advantage not to be overlooked, as repetitions involve delay.

The average speed of working is 23 to 25 words per minute, with ordinary commercial messages, or, in sending speeches through, 30 words can easily be managed. Of course it must be understood these results are only obtainable when efficient clerks are employed.

With regard to the "Bell"—in operation in England, only on the lines of the British and Irish Magnetic Telegraph Company—it also requires only one wire, but the signals in this case are read off by sound from two bells of different tone. It will be obvious that some degree of skill is required on the part of the clerk, and as he is unable to refer to a slip, and has to keep up with the sending clerk, a single word unreadable gives him the option of stopping the sender at once or having it repeated at the end of the message—thus causing delay. But, to counterbalance this disadvantage, a speed of 50 words per minute can be obtained; the average rate being from 30 to 40. The last Queen's Speech was forwarded per this instrument at the rate of 48 words per minute.

By these meagre but sufficient facts it will be seen the Morse is the most accurate—the bell giving the greatest rapidity. Which of the two advantages is the greatest, our readers can settle for themselves.

It should be mentioned that by an arrangement of the key used by the Electric Company, a wire in contact can be worked, whereas it would be useless with the bell system.

Our own opinion of the matter is, that taking them on their merits, they are each excellent in their way: and have no doubt that the bells, carefully worked with a careful, experienced attendant could produce as good results as the Morse—at the same rate of transmission.

ON THE ENGINEER'S SLIDE RULE.*

(*Continued from page* 113.)

The three principal forms in which materials present themselves to the artizan for measurement or weight are the cube, cylinder, and globe, consequently, the greater part of the tables on the Engineer's Slide Rule is devoted to the gauge points necessary for these purposes, hence we find three separate tables headed "square or cube," "cylinder," and "globe," and under these headings appear the F's and I's, which are simply contractions, for feet and inches.

The cube being a figure of three dimensions, viz.: length, breadth, and depth, and as those dimensions may be given all in feet, or all in inches, or partly in feet and inches, there are corresponding columns under this heading, giving "gauge points" to meet each case.

The cylinder has only two dimensions, viz.: diameter and length, and as the length is usually given in feet, and the diameter in inches, or occasionally both are given in inches, two columns only are devoted to this figure.

Lastly, the globe has only one dimension, viz.: diameter necessary for calculating its weight or cubical contents, yet two columns of gauge points are also required for this figure, since the diameter may be given in feet or inches.

The first line of gauge points under these respective figures is marked cubic inches, and is intended solely for measuring the cubical contents of bodies. Thus, if we had a piece of iron 1" long, 1" broad, and 1" thick, its solid content would be

* Contributed by Mr. W. Tonkes.

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$1 \times 1 \times 1 = 1$; consequently, when the dimensions of a body are given all in inches, our gauge point is 1. But if the body had been 1 foot long, 1 inch broad, and 1 inch thick, it then would contain 12 cubic inches, since one of the dimensions had been increased 12 times, and hence, after we obtained the contents by the ordinary method we should have to multiply by 12, requiring a second operation whenever the dimensions were given partly in feet and partly in inches.

To avoid this double work we find a decimal equivalent by dividing 1 by 12, which gives ·0083, and by dividing by this as a gauge point we perform the operation at once. So, also, when all the dimensions are given in feet, and we require to know the contents in cubic inches, instead of multiplying by 1,728, we use the divisor ·0,000,578, the gauge point under F. F. F.

The next line of gauge points is for the solution of questions where the contents are required in cubic feet, hence, where the dimensions are given all in inches the result must be divided by 1,728, the number of cubic inches in a cubic foot, hence 1,728 becomes the gauge point, but when two dimensions are given in inches, and the third in feet, as in the second column, the result, as before, would be 12 times too small, hence our divisor or gauge point must be 12 times less, or $\frac{1728}{12} = 144$, and when the dimensions are all in feet, the gauge point will of course be 1, or 1,728 times less than when inches only were used.

To find the gauge points for the cylinder it is necessary to consider that if a cylinder and cube are equal in length, their contents will bear the same proportion to each other as the areas of their cross sections, such sections being respectively the circle and square. It is well known that a circle, the diameter of which is 1, and a square, of which the side is also 1, bear nearly the same ratio to each other superficially as ·7854 to 1, hence if we divide the gauge point of the cube where the dimensions are given in inches by ·7854, we get $\frac{1}{\cdot 7854} = 1 \cdot 273$, the gauge point for the cylinder when diameter and length are in inches, and this result divided again by 12 for the reason already stated, gives $\frac{1 \cdot 273}{12} = \cdot 106$, the gauge point when the diameter is in inches, and the length in feet, and in like manner we could, if necessary, obtain the gauge point when the answer is required in cubic feet.

Again, it can be shown with regard to the globe that it bears very nearly the same proportion to a cube when the diameter of the one is equal to the side of the other, as ·5236 : 1, and therefore, by the same process as with the cylinder, but using ·5236 as a division, the gauge points for the contents of globes are determined.

The next point for consideration is the capacity of vessels, or the quantity such vessels would contain, the standard being the imperial gallon, which approximately contains 277 cubic inches, consequently, when the dimensions of the vessel under consideration are given all in inches, the gauge point is 277, and precisely the same rule as above given holds good for finding the other gauge points when the dimensions vary in kind or the vessel varies in form, whether cubical, cylindrical, or globular.

The other gauge points given in the three tables above referred to are designed for the purpose of finding the weight of bodies when the dimensions are given, those in the column III. being a table of the approximate number of cubic inches in a pound of the different materials named. Thus one pound of water contains very nearly 27·65 cubic inches, while one pound of copper contains 3·12 cubic inches, and so on with the others, and, as shown in the case of mensuration, all the other columns are deduced from this one by using the proper divisors.

It is evident that if we can by any means find the number of cubic inches in any body placed before us, and if we also know how many of those cubic inches of the material are contained in a pound by weight, by simply dividing the contents by this latter number, we at once find the total weight of the body, and this is just what we do when we attempt to find the weight instrumentally by means of our rule, and having the four lines of numbers and the proper gauge points, we are enabled in one operation to find the solid contents and the weight of the body when its form is either a cube, a cylinder, or a globe, thereby reducing rather a complex series of mathematical manipulations to one of the greatest simplicity. In cases of irregular figures a preliminary operation will reduce them to one of the three forms above enumerated, when the given rules become applicable, and practically these irregularities occur most frequently in figures of square section, the breadth very often exceeding the depth, such however, can with great ease be reduced to a mean square by the rule given for the "square and its root." In dealing then with the mensuration of solids, whether we require to find their solid contents, their fluid capacity, or their weight, one general rule holds good, and that is as follows:—All gauge points must be found on A, and placed against the length of the bodies found on B, then if the body be a regular figure, find the side of cube or diameter of cylinder or globe, but if irregular find the mean square or diameter on D, against which is found on C the cubic contents, fluid capacity, or weight, according to the nature of the question and the gauge point selected.

As an example, suppose we required the weight of a cast iron pillar, 10 feet high, and 10 inches diameter?

For cast iron in the column of cylinders under feet and inches (F. I.) we find the gauge point 407, and setting this number upon A, against the length, 10 feet on B, against the diameter 10" on D, we find the weight required, viz: 2,450 lbs on C.

To obtain this result arithmetically we should have to operate thus: $\frac{10 \times 10 \times \cdot 7854 \times 10 \times 12}{3 \cdot 84}$ a somewhat tedious operation, which would give as a result 2,459lb., or 9lb. more than obtained by the rule, a difference practically inappreciable, and arising not from any inaccuracy in the principle upon which the rule is founded, but from the infinitely small divisions that would have to be made in its construction in order to give the exact fourth figure, it is, in fact, a sacrifice of extreme accuracy to great simplicity and speed of manipulation, readily accepted as sufficiently close an approximation to suit all practical purposes.

(To be continued.)

MECHANICAL EQUIVALENT OF LIGHT.

For some time past it has been considered certain that light is capable of producing mechanical effect; but the relative amount of the latter was not hitherto determined. We have now, however, obtained the desired information on this point, by means of the researches of Professor Thomsen, of Copenhagen. He changed the light into heat, and then estimated the mechanical effect which the heat was capable of producing.

For this purpose he caused a beam of light, freed from all caloric rays, by transmission through a layer of water, to pass to a thermo-pile; and the heating effect thus produced was determined by the deflection of the multiplier.

During these experiments, various modifying circumstances were to be taken into account; thus, the absorption of luminous rays by the water was found to be 0·13, and this was to be allowed for. The indications of the thermo-multiplier were compared with the absolute radiation of heat, and it was ascertained that only one-seventh of the entire heat disengaged leaves the flame as radiant heat and light, the remaining six-sevenths being carried away by the heated air; but the more intense the light, the greater the radiation.

The conclusion arrived at was, that a flame whose luminous intensity is equal to that of a candle which burns 126·5588 grs of spermaceti per hour, radiates, per minute, light which, changed into heat, would raise the temperature of 63·28 grs. of water 1·8° Fahr.; and that light, whose luminous intensity is 34·9 times as great as that of the spermaceti candle, would raise 15,434 grs., or about 2 lbs. 3¼ oz. avoird., one metre (39·37 in.) high in a second—that is, would perform a unit of work.

The experiments were made with the light obtained from a spermaceti candle, a gas flame, and a moderateur lamp. Solar and electric light have not yet been examined.

Some curious calculations have been founded on the above results. Taking the total light of the sun as equal to 1,230 septillions of spermaceti candles, and that it would produce proportional effects, it would lift a weight equal to that of the earth twenty feet per second.

SUPPOSING the motion of the earth on its orbit were stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth 384,000 degrees of the Centigrade thermometer, or, in other words, the heat thus raised would be equal to that derived from the combustion of 14 globes of coal, each equal to the earth in size.

PETROLEUM AND ITS PRODUCTS.

In the treatment of petroleum almost every part of it is brought into a merchantile condition, even the residuum, or coke, which remains after the various oil and gases have been obtained is turned to account for fuel, being frequently used to carry on the several chemical processes to which the crude petroleum is submitted. The products obtained are—benzine or naphtha, burning oil, paraffin, and the coke. The naphtha, which is the lighter element, being something between a gas and a fluid, is driven off from 90° to 300° of heat, and constitutes about 15 per cent. in bulk of the crude oil. The lighter naphtha is now called gasoline, and from it an illuminating gas is prepared. The warmth of the hand will cause it to boil. A heavier distillation is used for cleaning purposes, and a still heavier has been used by painters as a substitute for spirit of turpentine. At from 300° to 500° the product of the still is a light oil, which, after treating with sulphuric acid and caustic soda, for the purpose of deodorising it, becomes the burning oil of commerce. This constitutes about 60 per cent. of the crude oil. As the heat is gradually increased from 500° to 800° heavy oil is produced, which, being treated in the same manner as the burning oil, is then barrelled up, and packed away in the cellar, with ice and salt, for the purpose of chilling it, as it is called. This is effected shortly, when, upon opening the barrels, the oil is found to have assumed something of the appearance of calves-foot jelly. It is then put into canvas bags, and being placed under a screw press, is subjected to an immense pressure. The finished lubricating oil is thus squeezed out, and separated from the paraffin, which is found in the bags in the shape of thin white cakes, which are almost perfectly tasteless, and in every respect resembling wax. This being purified, is used for the purpose to which common wax is applied, such as the making of wax candles, clear starching, the manufacture of chewing gum, &c. In its refined state this paraffin is worth from 20c. to 35c. per pound. The lubricating oil will, perhaps, make 9 to 10 per cent. of the amount of crude from which it is distilled. The paraffin may equal 1 per cent. At 800° the contents of the still will show a red heat. The distillation is then stopped, and the residuum, which is a sort of coke, similar in appearance to ordinary coal coke, is removed, and used for fuel.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

HOW GREAT COMPANIES REMUNERATE THEIR OFFICIALS.

Sir,—Your out spoken article upon the Corporation gas scheme is worthy of you. I for one wish there was a little more competition in other companies—it might be the means of some of the underpaid officials being better remunerated for their services. You may better understand me when I inform you that I am intimate with the manager of a department in a wealthy company paying 8 per cent. and a heavy bonus, free of all income-tax, and a fund of £50,000 of undivided funds, and although the directors, auditors, &c., know that this man has four children, his salary is only £96 per annum, the profits of his department are £9,000 per quarter, deducting £1,000 per annum for all working expenses.

CYNIC.

VELOCIPEDES.

Sir,—I have just seen your article on "Velocipedes," and wish your correspondents had sent in something of greater novelty in mechanism.

Now, Sir, being an amateur in this line, and having plenty of advantages to try anything I might wish, I beg to offer you my experience.

About twelve or fourteen years ago a friend of mine used to amuse himself with one of the old-fashioned dandy carriages with one crank and one handle. About eighteen months ago I looked it up, but it was too rude a machine to go at any speed: so I set about making one to carry one person upon the principle you explain in your valuable paper. But, alas, it would not work—scarcely able to move along a level road. I took it to pieces, and re-constructed it according to my own idea, and for two persons. When finished, we attained a speed of about six or seven miles an hour, but could not get up hill. Well, about six months ago, a postman between a village about six miles from Leicester, bought one called the "American Lever Pendulum Carriage." Mine then sank into oblivion against his, so I set about to put some parts to mine resembling in principle what seemed to me to be the secret of his. At last, about two months ago, I got it work. I also enlarged it to carry three, all working with both hands and feet, and I think it as near perfection in a velocipede as possible. With the roads dry we can attain a speed of ten to twelve miles an hour, and ascend ordinary hills with ease. It also carries two as easily and comfortably as three. There is a lock-up box on it to carry tools, &c., and some day I mean to undertake some long journey in it with a couple of friends. It works quite to my satisfaction, and, if desirable to you, I will send a description of it.

SCHNELLUG.

[We shall be glad to receive the description with drawings.—ED. E. M.]

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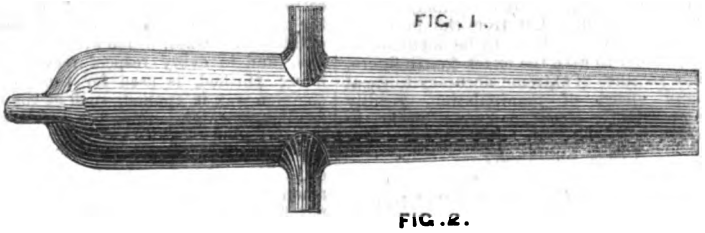
DISC SHOT CANNON.

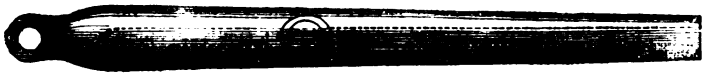
Sir,—Reading of the number of improvements that are being effected in fire-arms, I venture to send you a design which I think is quite novel, and possesses some advantages over others; the design I send you is that of a cannon and shot, which I term the disc shot cannon.

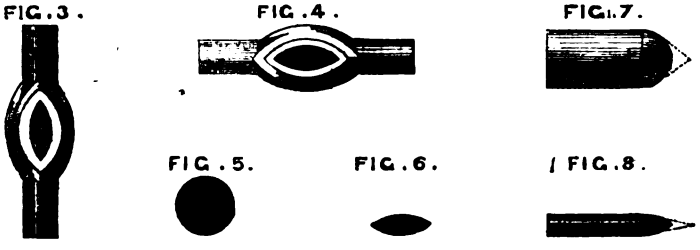
Fig. 1 is the plan view of the cannon; figs. 2 is the side elevation; figs. 3 and 4 are end views, and figs. 5, 6, 7, 8, are views of the shot.

The advantage which I think is in my plan is increased penetration; as you will observe in the shot that it is flattened, and that it has a very thin cutting edge, so that in rotating any object which comes in its way will receive the sharp edge, which would, according to my ideas, penetrate farther than those at present; the rotating shot, fig. 5 and 6, would receive rotation either by having the bore made deeper at one side than the other, or the shot could have indentations at the sides, as shown in figs. 5 and 6, so that the air would act against them and cause the shot to rotate; and the greater the rotation, the greater the penetration; as a piece of soft iron rotating at a very great speed has been known to cut through a hardened file, so that I am of opinion that my shot would produce more effect than a rifled one, as it would then act as a saw and wedge; of course on entering the material the rotation would be diminished, but then we must look at the rifled shot, they rotate and see the penetration which is due to their rotation.

I do not confine myself strictly to the shape of the shot and bore I send, as the shot may be quite flat and rounded or sharpened at its edges, or like a ring, hollow in the middle. Figs. 7 and 8 is another sort of shot; not rotating shots. The cannons could be made either with the widest part of the bore horizontal, vertical, or at any angle; it would be rather difficult to bore the cannons at first, as some alterations in the present machines would be requisite.







This is not the first time I have had the pleasure of sending designs to you for publication, as I sent a railway break to you which you kindly published in your paper of June 30th, of the present year; I therefore hope you will oblige me by publishing this, as I have other designs I should like to send you, which may prove very interesting to your numerous readers, and of course open to improvement, as there is room for improvement in everything. I must conclude, hoping you will oblige me by publishing this design. CHRISTOPHER JAMES LITTLE.

CORRECTION.

Sir,—In your impression of the 1st inst, you inserted five theorems from me on the safety valve lever, three of which the arithmetic sines were not correct.

1st. You have $\frac{a \times c}{b} \times c \times e = d$; which should be

$\frac{a \times c}{b} + c + e = d \ldots (1)$

2nd. $d - c\frac{(a \times b)}{b} = e$; which should be $d - c\frac{(a + b)}{b} = e \ldots (2)$

3rd. $b\frac{(d - c)}{a \times b} = c$; which should be $b\frac{(d - c)}{a + b} = c \ldots (3)$

J. S.

OUR SUBSCRIBERS' NOTES AND QUERIES.

OVAL CHUCK.—Never having seen drawings before of your oval and eccentric chucks for turning, nor any kind of those working apparatus, I must own I cannot thoroughly understand them. Would your correspondents kindly inform me if that kind of chuck can be applied to a common lathe, with face plate and back gear, or even by the foot? If so, how they are connected to the lathe spindle or face plate, their mode of operation and working, how to chuck the work to be turned, and if it can be turned by a hand tool, either in wood or iron; also, if the centres of the lathe have to perform any part in the work? Any information would be kindly accepted.—SYSTEMATIC.

LATHE MANDREL.—Can any correspondent assist me in a little difficulty? The mandrel of my lathe binds in the collar, and I cannot tell the reason. Both mandrel and collar are steel, both hard, and fitted as well as any I ever saw, and yet even when well supplied with oil, after turning some time, they heat and bind. Any explanation of the difficulty will be greatly esteemed by—A TURNER.

DRILL.—Will Mr. W. H. Northcott or any gentleman inform me of the kind of drill or rimer used for re boring gun barrels that are out of truth by long use and rust, and the manner in which such operations are performed?—CINA.

SILVERING.—Can any of your readers inform me how small articles of brass or iron may be coated with tin to have the appearance of silver plate?—BIRD'S NEST.

BOILER.—Can any correspondent furnish me with some idea of the most suitable sort of boiler to drive a small steam engine about two horse-power on board of a small pleasure boat, particular attention being paid as regards cheapness, usefulness, easy and little firing, and capable of rising steam quickly and retaining same, as, also to be in as little bulk as possible?—NAB.

MAGIC LANTERN.—Will some correspondent inform me the cheapest and best way to construct a magic lantern of sufficient size for a lecture room, to form a disc, say, six or eight feet diameter; also, the sort of lenses, their diameter and length of focus, also the best light to use, and how made.—W. SALE.

REMOVING VARNISH.—Can any contributor tell me of some means for removing the varnish called oak stain from timber without scraping or staining the wood, as potash does? Also, the best composition with which to paint the masts and spars of a yacht after having been scraped?—YOUNG YACHTSMAN.

CASTING.—Can any correspondent inform me of a first class mixture of metal for casting steam-engine cylinders?—BRISTOL.

SILVERING STEEL.—Can any reader inform me, first, the process of brazing without heat; second, of blueing steel without heat?—C. K. L.

ADDRESS WANTED.—J. K. wishes for the address of Mr. S. Taylor, whose letter on the Atlantic Telegraph Cable appeared in THE MECHANIC in June last.

CORNISH ENGINE.—Can any reader inform me where I can procure, in a cheap form, a description of the Cornish engine, with illustrations, such as used in the various London water works companies? I am the inventor of a low pressure ball cock, and should be glad to dispose of it, or join some really honest person in bringing it out. Its merits are, first, that it is effectual; second, it is very cheap; third, it is not worth stealing; fourth, it cannot easily get out of order, and if it does a child could repair it.—A. N.

METALLIC PAPER.—How is this paper (which is used for pocket-books) prepared, and of what metal are the points for writing upon the same made?—Z. Y. X.

CIRCULAR SAW.—I have had a circular saw frame (foot power), ten years for cutting Jacquard nogs used in lace machinery, but cannot make it cut more than ¾ inch thick to work comfortably. Beyond that, it becomes labour, and the power ought to be steam, or does Mr. A. Lee think the panel saw preferable?—BUTT JOINT.

FRET SAW.—Will Thos. E. Merritt oblige me through your journal with a few figured details of his fret saw, and the thickness it will cut hard wood, and oblige.—BUTT JOINT.

OIL WORKS.—Will any of your kind Chester readers give me the proper address of the Paraffin Oil Works or Oil Refinery at Chester? W. H. H.

COMPOSITION SAW DUST.—Can any of your readers inform me how to make composition saw-dust, such as is sometimes used to make medallions?—THOS. WOOD.

MELTING BRASS AND COLOURING GOLD.—Can any reader answer the following questions:—1. When I melt brass by means of the furnace described in No. 28 of THE ENGLISH MECHANIC, the melted metal does not pour well; how can I make it run easily into the small moulds which I use, so that it will not run out in a thick heavy mass? 2. How is 18 carat gold coloured?—MILLA NICK-NACK.

HARDENING STEEL.—Many thanks to the several correspondents who so kindly answered my enquiry for screw threads. For the information of novices like myself, I beg to record the following:—I tried to harden two pieces of steel in a domestic fire, and failed. I used the bellows, which made matters worse, the file cutting it like iron. I thought it probable that the blast impinging on the steel abstracted some of the carbon, similar to the Bessemer furnace. I tried again, by placing the steel in the fire above the blast. I blew it very hot, taking care, by noticing the colour of the fire round the tool, that the cold blast did not touch the steel. I succeeded with best results—the steel seemed to absorb fresh carbon from the fire. Perhaps some of your practical correspondents can throw some light on this point?—ARROW.

GALVANISING.—Will any reader inform me of the best and cheapest apparatus for galvanising iron hooping in bars?—COOPER.

WATER GAUGE.—If the glass tube of a water gauge, or a steam gauge be cleaned out with a wire, even when the tube is quite cold, it is sure to break in some hours afterwards. I should be glad to know from some of your correspondents the cause of this.—BRITTLE.

JAPANNING, &c.—Will any subscriber inform me how to japan iron for parlour ornaments, the materials of which it is composed, and the best method of using it? also, the best form, cylindrical or spherical, of a copper boiler, to hold about eight gallons for a working pressure of about 25 lbs., the best method of making it, and the price?—MORGANUS.

FRET SAW.—I should esteem it a favour if Thos. Merritt would furnish the following information respecting the fret machine as inserted in a recent number, where it can be procured, the probable cost, if driven by hand or steam power, and the force required, and if he would grant a personal interview?—JOHN HERBERT.

BRONZING.—Can any correspondent inform me of a good way of bronzing medals?—B. Kingsland.

GERMAN YEAST.—Will any reader of THE ENGLISH MECHANIC kindly inform me how to make quick German yeast, such as is imported from Germany?—BAKER.

VELOCIPEDES.—Will any reader kindly inform me which is the proper kind of teak, and where to obtain the best felloes for velocipedes?—N. J. W.

ATLANTIC CABLE.—What amount of pressure is there on a foot or square inch of, say, the Atlantic Cable? what pressure does it sustain at 30 feet under the surface, 100 feet, 1,000 feet, and one mile?—MAGNET.

ENGINE VERSUS WATER WHEEL.—Will a 10-horse engine cylinder consume as much steam as a 10 horse-power water wheel consumes of water? or, rather, perhaps, would the same quantity that turns the water-wheel be the same as would work an engine of the same power?—MAGNETISM.

REPLIES TO QUERIES.

THE PLANETS AND CHEAP TELESCOPES.—It would be absolutely impossible to answer your correspondent, Mr. C. T. Whitmell, without encroaching exceedingly on your space. I may, however, just say that for the planets to describe circles round the sun the force with which each was originally projected must have been precisely equivalent to the velocity which it would have acquired by falling through half the radius of the circle. The great improbability of this exact coincidence will be at once seen; and any deviation from it necessitates the description of an ellipse by a planetary body; or, in an extreme case (as that of a comet), where the projectile force preponderates much over the attraction of the sun, of a parabola, or even a hyperbola. I am, of course, ignorant of the amount of Mr. Whitmell's mathematical knowledge, and have, therefore, some diffidence in referring him to sources of information; but I should think that consultation either of Tomlinson's "Mechanics," (part 2, sec. 3), or of Main's "Astronomy," (chap 4), would suffice for his purpose. I mention these books on account of their cheapness; they only cost a shilling each and are published in Weale's series. One word as to cheap telescopes. All the directions sent by your correspondents are merely what is called at Cambridge "crib" from the works of the late Dr. Dick. I well remembered the "36 inch and 1 inch convex lenses," when I cautioned Athelstane against a non-achromatic object glass. Should he and Magnifier however, determine each to construct one of these fearful and wonderful instruments, I can only recommend them to try and attain the frame of mind of the man in *Punch*, who went for four ounces of mixed tea; and who while he "hoped for the best, was prepared for the worst."—A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

In reply to C. B. M. S. I know of no such rule as that he enquires for, nor until some new method of proportion is discovered, wherein, with two numbers given to find the remaining two in order to complete the proportion by a single operation, is it very probable that such rule will be found. A range at leisure through the fifth book of Euclid would be of service to C. B. M. S. Ebonite discs, already prepared, and with finely polished sur aces, can be obtained of Messrs. Silver, the patentees, Bishopsgate street, London. Price about 4s. per weight. For the cushion of mine I use common wash leather and the usual amalgam, same as applied to glass discs. My plate 14" diameter × ¼" thick weighs about 1½ lbs. as nearly as I can remember.

I think Theo. can buy a disc ready turned cheaper than buying sheet ebonite to construct one, and very muc

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cheaper than a glass one, with the advantage of far higher insulation and no liability to fracture. In fact, in all cases where it is applicable in the construction of any electrical apparatus we may say without flattering the inventor, "There's nothing like ebonite."

J. C. Wigg. I believe there is not even an empirical law yet formed for determining the length and thickness of wire for the electro magnet in such machines, almost every maker varying in accordance with his opinion, and the purpose for which the machine is designed, from the simple medical toy up to Elkington's electro plating, and beyond that to Prof. Holmes' electric light machines

What you have to bear in mind is that you are dealing with "high tension electricity," to which well insulated copper wire, however fine or long, offers but slight resistance, while every additional turn increases the extent of your effects up to a certain point, which experiment with your machine alone can determine.

Oh susanna, you can readily deposit iron on gutta percha, using a solution of sulphate of iron, with a plate of iron as a cathode The moulds must be well and evenly covered with plumbago, for which purpose gutta percha is eminently fitted. Use Daniel's battery, and increase the tension as may be found necessary.

Vincent C. Davis. In coupling for quantity, you join up all the carbon plate terminals to each other, to form one pole of your battery, and all the zinc plates in like manner to constitute the other pole. But in doing so, you affect something which hitherto you have most probably overlooked, viz.: decreased the tension of your current three times, hence if you use the same external resistance (the wire which conveys the current from and to the battery), you will certainly find that you get less quantity than when you had the arrangement for tension. While, if instead of using the same wires you substitute very short and rather thick terminals, you then find the advantage (for certain purposes only, mind) in altering to quantity. I regret, that in consequence of the limited space at the command of the Editor, I can only supply you with bare facts without a rationale, but since we are promised a "double number at Christmas," I may, if time permits, revert again to this and kindred subjects.—Wm. Tonkes.

Boiler Construction.—I am sorry that Aspirant does not understand the system of my boiler. Its principle combines a mode for preventing furrowing, and adding strength to the boiler without increasing the weight to any great extent. There have been several theories offered on the corrosion of steam boilers; one of these is, that, carbonate of lime decomposed from the feed water by the heat, is forced by the pressure and the current into the expanded seams, these attempting to return to their original positions, are opposed and resisted by minute particles of this destructive agent, which, on account of its great hardness, is enabled to cut, and thereby destroy with great facility the fibres of the plates. The theory, however, to which I am inclined to give the preference, is, that chemicals derived from the water lodge on the edges of the plates and seams, causing a galvanic action, thereby destroying the plates

Taking this into consideration I saw that if a boiler could be so designed that there would be no lodgment whatever for these chemicals, and that if the plates did corrode they could not give way of themselves; and, when they did give way, they would have given ample warning beforehand—that such a boiler would be a great improvement. Some time after I designed the boiler, the merits of which are at present under review; and an attentive examination of the drawings will show that it possesses all the above merits. The edges of the plate meeting flush, unless the boiler expands to an unusual amount, there will be no lodgment for any of these agents; then (looking at the figures 4 and 5), if by any unlooked for manner the plates corroded, the joints would leak to such an extent long before there would be any danger, that the attendant could not help noticing the leakage. The strength of the boiler does not depend on the plates and riveting alone The strain of the plates being thrown on the riveting and flange plates; as these latter cannot give way without withdrawing the wedges on their ends, the wedges must be crushed, and throwing the strain on the hoops, burst them before the plate could give way.

I hope that Aspirant and others will fully understand the above explanation, and shall now proceed to Aspirant's letter of Nov 24th. I daresay that Aspirant fully understands the method of calculating the strength of boilers, and likewise of steel hoops subjected to strain, in which case he will perceive that the strength "the hoops would only add" will be according to the area of their cross section in their weakest part. Aspirant prefers thick plates for the boiler, and dispensing with the hoops, his experience may have taught him to do so, I will therefore show him some of my objections. Boiler plates diminish in their tenacity after they have been heated to a certain temperature (550°); passing that point they begin to diminish very rapidly till they arrive at the temperature of 1,300°, when the tensile strength has fallen to about 8,000 lbs per square inch of section. An accidental overheating will have the same effect, but to a greater degree Iron increases in weight to its strength in a greater proportion than steel.

One of Aspirant's objections to rivetting is the fact that punching the rivet holes will injure the plates. As such is the case, why does he recommend thicker plates? The punching will injure them to a greater degree than it would the thin ones; if he drilled them it would take a longer time, and heavier machinery; were he to weld them it would take more labour and there would be a greater certainty of a deficient joint. For these reasons, I should recommend him to use thin plates whenever it is possible; to drill his holes with such a drill as is used by most engineers of the present day, which will drill from 6 to 20 holes at the same time.

I shall not notice Mr. Jenkins' letter, beyond thanking him for his complimentary opinion and conclude by informing him that the system he recommends is exceedingly like a system, patented by Mr. Galloway, introduced some years ago, and that, if I employed tubes "of a little less substance," that it would so obstruct the passage of the hot air and smoke, that I doubt if it would produce a sufficient blast; nevertheless, he will doubtless hear of me some day at the Masoro' Boiler Works, with due thanks for his kind invitation.—Adrian Neison.

Magnets' Condensers.—In reply to F. Donnelly. It is essential that the springs S, S, in my sketch of a magneto machine be brought in metallic communication with the terminals T, T. The dimensions of the steel magnet are as follows:—10 inches high, 2½ inches in breadth, by 2 in depth. If expense is an object, a horse-shoe magnet of the dimensions given, made of cast iron and magnetized in the usual way will form a good substitute for the steel magnet, and if not quite so effective is considerably cheaper.

F. R. S. A. It is a difficult matter to entirely destroy the influence of a magnet on an object a short distance off, by inserting a substance between them If it is merely wished to partially destroy this influence, it may readily be done by inserting a soft iron armature between the two; the closer the armature to the magnet, the less will be its influence on the object.

A. H. V. and Wm. Gibson will find the condenser described in No 20 of The English Mechanic attached to the contract breaker of induction coil or magnet in following manner. Solder or otherwise fasten a piece of wire to each side of contact breaker, selecting the most convenient part for that purpose. The opposite ends of these two wires should be soldered to a couple of thin discs of copper (about the size of a penny piece, but much thinner), the surfaces of which ought to be well tinned. Finally, bring one of these discs of metal in contact with the sheet of foil forming one end of condenser, and the other disc to the sheet of foil forming the opposite end or side of condenser. The discs of metal are kept in their respective places by pressure. Single sheets of tinfoil may sometimes be purchased at an operative chemist's at 2d. per sheet. Tinmen generally sell it by the pound 2s. 9d. is about the price.

C. C. You can obtain sheets of India rubber either at Silver's Bishop gate-street, or at Macintosh and Co., Cheapside.—Edwin Furze

Pressure on Valve.—In reply to your correspondent J M. S., I beg to state that the pressure upon the valve (per his sketch), will be as follows:—

The lever being of the second kind, the effective weight of which will be equal to 6⅜ (2″ 14,)=19″ 15 11·16=19·9804, and by a known property,

$$\frac{33 \times 9\frac{1}{4} + 19\cdot9804}{2} + 1\cdot4373 = 166\cdot1153 = \text{weight upon}$$

valve. Now the area of the valve = 2·4053 square inches,

$$\therefore \frac{166\cdot1153}{2\cdot4053} = 69\cdot062 \text{ lbs. pressure per square inch, as}$$

required.

The answer to the second question is as follows:—

60 (2·4053) −1·4373 = 142·8805 lbs effective pressure on lever. Now let x be the distance from the fulcrum required.

Then 33 x + 19·9804 = 2 (142·8805)

$$\text{Whence } x = \frac{2\,(142\cdot8805) - 19\cdot9804}{33} = 8\cdot0539.$$

The distance from the fulcrum is therefore 8 1·18″ inches I trust this will meet the requirements of your correspondent.—James J. A. Flower.

Oil for Clocks.—Seeing a correspondent wishes for a receipt, I beg to offer one I have found very good It is to take about 4 ounces of the best sperm oil, put in it about 2 teaspoonfuls of ordinary carbonate of soda; warm it slightly and shake as much as you like. Then set it aside for a week or so to settle. Use of course the clear oil from the surface. This process removes all acid from the oil, which will otherwise turn the brass &c. green. For ordinary purposes good sperm oil is better than any other, as it does not get hard and sticky—A. H.

To Soften Cast Iron—If pickling in dilute nitric acid does not answer, place the article in a clear fire, and heat it to a dull red for half an hour It must not get too hot, or it will crumble up when pulled out. Then let it cool as slowly as possible. If the heat be a bright red, owing to the extreme brittleness of cast iron at that heat; it will almost certainly break. At least, that has been my unhappy experience over a clock wheel—School of Mines.

Steam Valve.—J. M. S. will find the following a correct answer to his query on pressure on steam valve in No. 35 When the valve is loaded as in the sketch, steam will begin to blow off at 69·9 lbs per square inch.

The weight should be placed 8·128 inches from centre of fulcrum or point pin, to obtain a pressure of 60 lbs per square inch on boiler.—W. H J P.

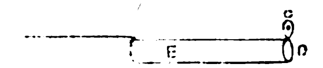
ASTRONOMY.

Sir,—I am pleased to see by the pages of your valuable work that an interesting and ennobling branch of science, viz: astronomy, is the subject of inquiries from numerous correspondents.

Mr. E B. Wegg has given instructions how to make an astronomical telescope for £2 10s., an instrument at such a price very few "English mechanics" could buy or make. If you will allow me the space for the following description and diagrams, I will endeavour to instruct those readers who are interested in the subject how to make a telescope which will show the satellites of Jupiter, the rings of Saturn, the mountains and valleys in the moon, at the cost of a few shillings. First, we require two lenses, diagram below illustrates the kind, for an astronomical telescope; they are called double convex.

The object glass is the large lens placed at the end farthest from the eye; the most convenient kind is 48 inches in focal length, the price 2s. 6d.; the eye glass is the one nearest the eye, its focal length should be 1 inch. Price 1s. The two will produce a magnifying power of 48 times.

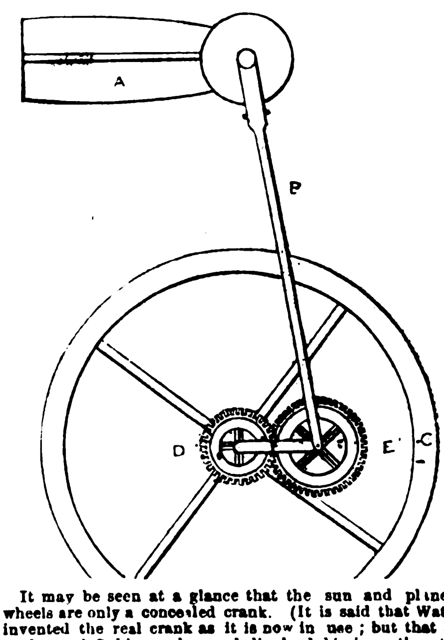
The tube can be made of brown paper, or you can have it made by a tinman for a small sum If you intend to make it of brown paper, commence by pasting sheets round a roller 42 inches in length, 2¼ inches in diameter, let each layer dry before you paste the other on; now into one end fix your object glass, commence making tube No. 2, it must be 8 inches in length and must just slip into tube No. 1; in one end fix your eye glass, then slip one tube into the other so that it can be drawn in and out at pleasure It will be necessary to provide a cap with a hole about ¼ an inch in its centre, to slip on the smaller tube, and to which the eye is placed. It may be as well to mention that in looking at some objects, it is necessary to contract the aperture, this may be done by means of a piece of card perforated with holes of different sizes. If your telescope is made correctly it will be like the following diagram.



A, object glass; B, long tube; C, the cap; D, eye-glass E, small tube. Ed. McGurk.

SUN AND PLANET MOTION.

Sir,—In answer to C. W. (Peterboro'), I send a drawing and description of Watt's sun and planet motion.



It may be seen at a glance that the sun and planet wheels are only a concealed crank. (It is said that Watt invented the real crank as it is now in use; but that a workman left his employ and divulged his invention to another man, who immediately produced a crank on Watt's plan, but took the credit of the invention to himself.) Watt was obliged to invent this motion to render his engine complete without any other person's production.

A, is the beam; B, the connecting rod; C, the fly-wheel; D, the sun wheel; E, the planet wheel, and F, a bar of iron connecting the centres of the sun and planet wheels.

On the axis of the fly wheel, C, is fastened a small concentric toothed wheel, D; a similar toothed wheel, E, is fastened to the connecting rod B, (which comes from the end of the beam), so that it cannot turn on its axis, but must rise and fall with the motion of the beam.

A bar of iron, F, connects the centres of the two small toothed wheels, D, and E, when therefore the beam raises the wheel E, it must move round the circumference of the wheel D, and with it turn the fly-wheel C, which ought to make two revolutions while the wheel E, goes round it once; thus D, like the sun, turns only on its axis, and is consequently called the sun wheel, while E revolves about it as the planets revolve round the sun, and is, for this reason, called the planet wheel.

David Sloan Thomson.

The number of locomotives on the railways of Great Britain, at the close of 1864, was 7,203: while at the close of 1863 it was only 6,643 To the increase of 560 here disclosed, England and Wales contributed 361; Scotland, 168; and Ireland, 31. At the close of last year English and Welsh railways had 5,708 locomotives between them; Scotch railways, 1,072; and Irish railways, 423

Humboldt stated that guano is deposited in layers of 50 feet to 60 feet thick on the granite of many of the South Sea islands of the coast of Peru. During 300 years the layer of guano deposited is only a few lines in thickness. This shows how great must have been the number of birds, and how many centuries must have elapsed to form the present guano beds.

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THE ROYAL OBSERVATORY AT GREENWICH.*

In the long course of experience gained since the first day of the establishment of the Royal Observatory at Greenwich, the astronomical apparatus at that institution has reached a very high state of perfection. The work that is daily executed at the Observatory has for its object the mapping, with the greatest accuracy possible, the places of the fixed stars, so as to obtain zero points in the heaven with which to compare the positions of the moveable planets. These points of reference are of the greatest use to navigators, who require reliable information as to the position of the brighter fixed stars on given dates, which positions can now be determined at the Observatory many years beforehand with very considerable accuracy. The position of the moon also, is calculated with the greatest care. From time to time the observations taken at Greenwich find their way into the *Nautical Almanac*, in which the alterations are not made at one, but every few years, when the discrepancy between the two becomes too great, so that ultimately all the figures in the *Nautical Almanac* are founded on the Greenwich observations. The deductions also are used to correct the solar tables, and the observations of the moon at Greenwich are employed to compare with and test the accuracy of the tables of Hansen.

The principal instruments at the Observatory are the great transit circle, the altazimuth, the zenith tube, and the great equatorial telescope.

The great transit circle was designed by the Astronomer Royal, Professor B. G. Airy, and the engineer's work was planned by Mr. May, of the firm of Ransomes and May, afterwards Ransomes and Sims. Mr. May first suggested the cast iron tube of the instrument, and the object glass was ground by Mr. Simms the optician. The instrument is supported on two massive stone piers pierced with a few holes for the reading microscopes, and built up from a deep firm foundation in the earth, in order to avoid vibration. The roof overhead has four shutters along its ridge, easily opened by the mechanical appliances in the room. The tube of the telescope is rather less than 12ft long, and has an object glass 8in. in diameter. The tube is supported on an axis consisting of two pivots and cones, each pivot being cast in one piece with its cone, but not under similar circumstances. It was necessary, to ensure accuracy, that the pivots should be of very hard metal, and very truly turned. The mould for the pivot was made of iron, to chill and harden the metal, whilst that of the cone was made of sand. By this process pivots were obtained nearly as hard as steel, being afterwards shaped and polished with emery, with the same care as in grinding glass for a lens. The length of the axis of the telescope between the ends of the two pivots is 6ft. The pivots are 6in. in diameter, and in order to test their accuracy from time to time, they are perforated and a plate with a very small hole through its centre is fixed on the eastern pivot. In the hollow of the western pivot, at the distance of its focal length from the plate, a lens is fixed, the collimator thus formed being viewed when desired by a telescope of 7ft. focal length. As yet no error has been discovered in the form of the pivots by this rigid test.

The flexure of the cast iron tube as attached to its axis has to be tested occasionally. This was done soon after it was first erected by placing an object glass in the centre of the tube and fixing a cross of wires at the object end, so that the image of them should be formed at the eye-piece. The telescope was then placed in a horizontal position, with its object end north and the place of the image at the eye end measured with the declination micrometer. The telescope was next turned over till it rested in a horizontal position pointing south, and the place of the image again measured. In two readings, taken in 1850 the difference was 0r. ·204,0·00414 inch, one-half of which, or 0·00207 of which was the effect of flexure, a variation of no practical importance. The flexure is now regularly noted from time to time, by a process hereafter described.

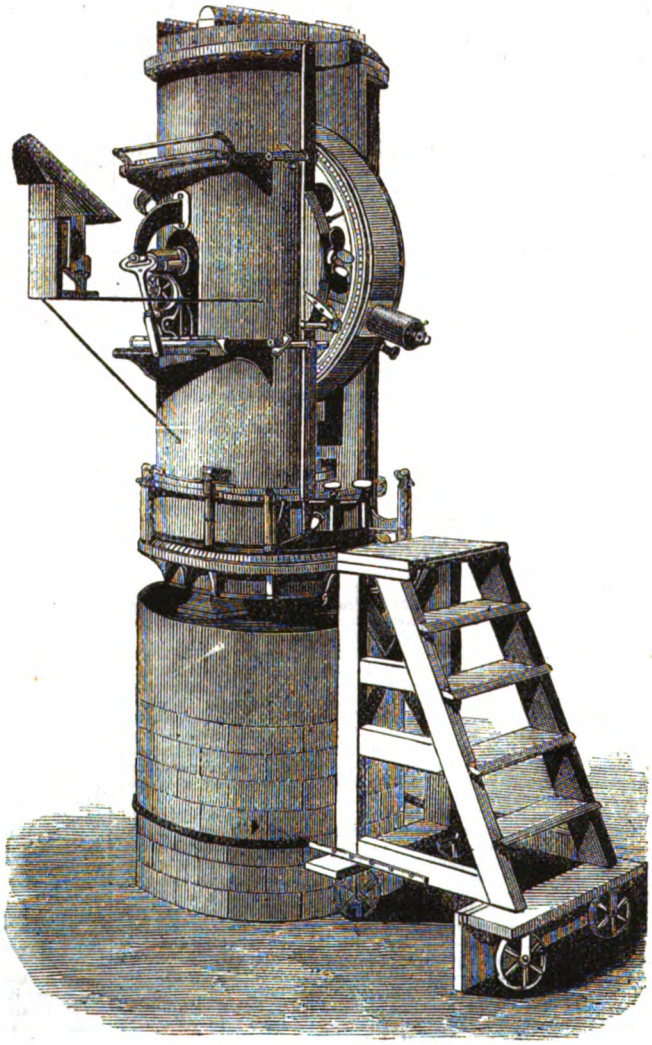
The meridian of Greenwich, as stated in school books, is an imaginary line, passing through Greenwich from the north to the south pole; and by noting the instant that fixed stars cross this line, Greenwich time is obtained. Unfortunately the line *is* imaginary, hence the difficulty of ascertaining exactly when the stars cross it, so one by one the astronomer has to eliminate the sources of error. He, however, can easily find the zenith, also the centre of the small orbit described by the north star; so, should he first point his telescope to the zenith, and then depress it till he sees the north star, the telescope will have described a segment of circle in the true meridian of Greenwich. On looking through the telescope a number of fine vertical wires are seen crossing its field of view, the central one in the axis of the telescope representing the meridian; so, were the whole of the apparatus perfect, every time a star passes that particular wire it would also cross the meridian. Although the transit tube, with its iron axis and stone supports, only has the power of swinging over from the north to south, and cannot be turned toward the east or west, the mere mechanical arrangement is not sufficiently accurate for astronomical purposes.

For instance, should the tubes yield a little, the micrometer wires shift, or other faults in the telescope itself appear: a distant object in a line with the longitudinal axis of the telescope will not be represented by the object glass exactly upon the central micrometer wire, but to the right or left of it: so, should the astronomer register the time it is seen to cross that wire, he will do it at a period when the star is not on the true meridian. This source of inaccuracy in time and calculations is known as "the error of collimation." Now, if one fine perpendicular wire were fixed ten miles to the south of the transit tube, and another ten miles to the north, both being exactly in the meridian, the astronomer could first point his transit tube to the south wire, and make its image fall upon the central micrometer wire by adjusting the latter, and then, on turning the tube over, if he found the north wire also coincide with the micrometer wire, he would know that he had the true optical axis of his telescope marked by the wire representing the meridian.

Two fine wires, however, cannot be fixed in those positions a few miles on each side of the Observatory, or if so fixed could not be seen when wanted. If they were fixed in the walls of the room they could not be brought to a focus in the great transit telescope, so the alternative is to fix them on each side of the room, interposing lenses between the wires and the telescope to atone for want of distance.

The principle being thus explained, we cannot do better than quote the technical description of this arrangement in the words of the Astronomer Royal: "For determining the error of collimation two horizontal telescopes of about five feet focal length, and nearly four inches aperture, with their object glasses turned towards the centre of the instrument, are mounted on Y's, which are carried by massive brick piers, one on the north and one on the south side of the transit circle. The height of the axes of these telescopes is as nearly as possible the same as that of the axis of the transit circle. Each telescope is furnished with wires in its principal focus, to be used as collimating marks; and each telescope may be used as a collimator for the other, or for the transit circle telescope. The system of wires is the same in both, consisting of two parallel wires inclined to the vertical at an angle of about two and three-quarter degrees; two other parallel wires at right angles to the former, and therefore inclined to the horizontal line at the same angle (the intersection of this pair with the former producing a square), and a fifth wire parallel to the two last mentioned, and at a distance from the nearest of about ten times the side of the square. The middle portion of the fifth wire, which is included by the two nearly vertical wires, is in the same vertical with the middle of one of the nearly vertical sides of the square; and these middle points are the points adopted for observation. These wires are finer than the others." The frame carrying the north collimator wires are adjusted in altitude, and the frame of the south collimator in azimuth, by means of micrometer screws. To view one collimator by the transit circle telescope is easy, but to view one collimator by the other the transit circle has to be raised out of the way by mechanical appliances, and this is done every Monday.

An observation for the collimator of the transit telescope is made every night, the axes of the telescopes used as collimators having previously been brought into the same line with each other, or at all events strictly parallel. The central vertical wire of the telescope is then brought several times in succession upon the proper point of the nearly vertical wire of the north collimator, and the same operation is performed with the south collimator, the micrometer being read for each coincidence. The mean readings of both give the reading for the position of the line of collimation.



(To be continued.)

(* Extracted from the *Engineer*.)

TOOL HOLDER FOR THE SLIDE REST.

THE illustration hereunto appended is, we believe, of Professor Willis's tool holder for the slide rest. In many cases no provision is made for placing the tool in various angular positions, and thus, if it is necessary to present the point of the tool to the work in an oblique direction, the tool itself must be bent, with all the consequent risks. By using Mr. Willis's contrivance, the tool may be fixed at any required angular position upon the table of the slide rest, and is besides capable of being entirely removed from the table, so as to leave it free for the others—as for drilling, cutting wheels, &c.

Fig. 1 is an elevation of the tool holder; Fig. 2 is the same shown in plan.

The tool is fixed by the action of a single nut A, tapped to the screw pillar B, C. This screw has a

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shoulder bearing on the surface of the table, and beneath this shoulder a short portion of screw C is tapped into a hole in the table; thus, the screw pillar can readily be removed by the key applied to the flat faces filed on the shoulder. It will further be observed that the pressure of the nut A is exerted on the triangular clamping piece D, E, F, Fig. 2, through the washer G, which, it will be seen, works freely in a corresponding cavity in the clamp, as shown in Fig. 1. Two steel studs, D, E, are driven into the lower side of the triangle, and rest on the upper surface of the stem of the tool. A screw, at F, is tapped stiffly into the triangle, and its lower end being rounded like the studs D and E, it follows that when the nut A is brought into action, its pressure upon the triangle is resolved upon the three bearing points below. To alter the angle of presentation, the nut is loosened, and tool and triangle are free, when the desired alteration is made, and a turn of the nut tightens all up again. But as it is necessary the tool should remain under the studs D and E, and so always at the same distance from the centre of the screw, the intermediate piece H, upon which the stud F presses, is contrived also to answer the purpose of guiding the stem of the tool readily to the distance. The dotted line *k*, *l* is the boundary of the lower

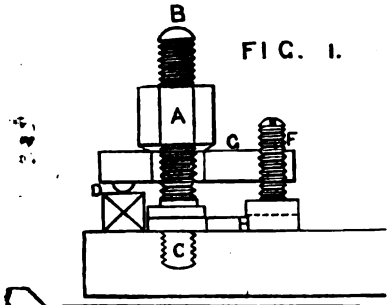


FIG. 1.

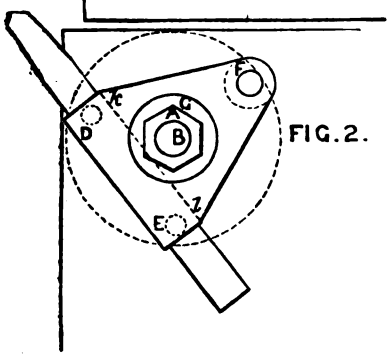
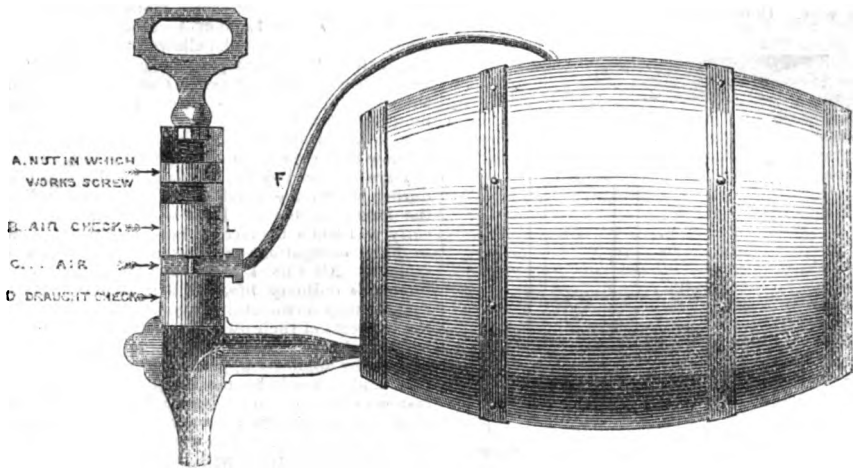


FIG. 2.

piece; at the opposite extremity a thick lump is formed in which a "pointer" notch is filed to show the centre of the screw pillar. This notch or groove, as explained, takes the end of the screw F. The form and thickness of the lump and the position of the groove are shown by the dotted lines. The triangle D, E, F, and the washer G, are drawn in section in fig. 1 to explain the adjustment of the latter. The upper surface of the washer is always horizontal, therefore the hole need be no larger than just sufficient to pass up and down the screw pillar. But it will be evident that as the tools to be accommodated vary in thickness, the case is different with the triangle; and, therefore, as indicated in the section, the hole through which the screw pillar passes should be large and slightly conical. The screw pillar should be fixed on the table of the slide rest at such a distance from the two edges that the three bearing points of the triangle may not hang over the edges in any position, but the tool clamped within the limits of the table—the dotted circle explains this. A circular hole in the centre of the piece H fits the shoulder of the screw pillar, the end of screw F is received in the groove of the intermediate piece—which latter is thereby kept in position below the triangle—and thus the triple combination may be swung round the central pillar without any derangement of position. The introduction of the screw F is to allow for the admission of tools of varying thickness; but as the spherical washer allows of pressure from the nut being transmitted equally to the bearing points, it follows that wedges of necessary dimensions may be readily applied to D, E, or F, in order to raise or depress the point of the tool. The tool may be placed either to the left or right of the screw pillar, and a spiral spring may be introduced below the triangle, to prevent it dropping on the removal of the tool. Lastly, the triangle should be of such a size that the distance between its bearing studs D and E shall be the same as that given to the binding screws of an ordinary tool holder.

NEW VENT TAP.

Sir,—The enclosed "Tap" is simple and effectual as a preventitive against sour beer. The idea may be useful to some of the readers of your ENGLISH



MECHANIC. The action of the thread in nut A removes or replaces pistons B and D over the air inlet, or draught outlet; F is an indian rubber tube, connecting a passage from cylinder L with the barrell.

J. W. W.

SOLDERING.

THE appearance of this heading this week in our journal will indicate to "W. W." and "J. S.," two gentlemen who communicated with us some month or two since, how long it takes to satisfy in rotation the desires of our readers. That shown, we now proceed to remark on the modes of applying heat in soldering, which varies according to the size of the work, the manner in which it is to be soldered, and the fusibility of the solders. In hard-soldered works the fires used resemble those employed in forging iron and steel; in fact, the blacksmith's forge is used for brazings. Coppersmiths and others use a similar hearth, but it stands further away from the wall to allow of the centres of large objects being soldered; the bellows are generally worked by a chain from the rocking staff.

FIG. 1.

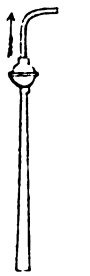
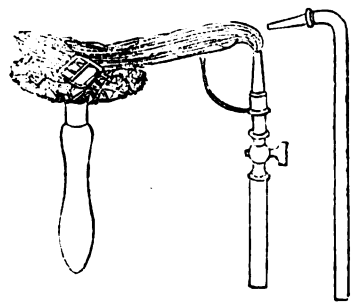


FIG. 2.

The brazier's hearth is a flat plate, 4 × 3 feet, standing on four legs in the middle of the shop; but there are various contrivances for use out-of-doors, when workmen go out to jobs. The surface of the plate supports the work over the central aperture for the fuel, which is 5 or 6 inches deep, and about 2 feet long and 1 foot broad. The revolving fan is commonly used for the blast, and the tuyere irons are loosely fitted, to render removal easy. The hearth-hood is generally suspended from the ceiling, having a counterpoise weight in the most handy position, to admit of the hood being run up out of the way, or elevated to allow of the admission over the fire-aperture of large work, such as where a large T-shaped pipe has to be brazed. Very often, in using the common furnace, a muffle is inserted in the fuel so as to concentrate the heat on the object, but the amateur is generally content to use a chafing-dish containing charcoal, the bellows being "actuated" by the attendant sprite. Care is taken to use charcoal or cinders in brazing, so that there is no danger of the presence of sulphur; in fact, the charcoal is often heated through, to drive off any sulphur. Another enemy to a good joint is lead, and a fire used for tinning should never, if possible, be used for brazing.

But the majority of cases in which soldering and brazing are applied in the manufacture are those which require the application of heat, together with the power of observation, guidance, and definition of the pencil; and these conditions are only obtained by the blowpipe, where the gas is driven forcibly on the object by the use of the lungs as bellows, the object itself being often retained on charcoal, so as to retain as much of the heat as possible given from the flame of the gas. The ordinary blowpipe is a slightly conical brass tube, about a foot in length, from ¼ to ½ inch diameter at the mouthpiece, and from 1-16th to 1-50th at the jet; the end is bent to keep the flame under observation. Fig. 1 shows the tool fitted with a ball for collecting the condensed vapour from the breath. This ball is best seen by the enlarged section at Fig. 2, where it is also shown that, the tube being discontinuous, no vapour can proceed in the direction of the arrow. The most intense heat of the blowpipe is that of the *pointed* flame; for, with a wax candle and a blowpipe having a small aperture placed slightly within the flame, small fragments of the metals are melted,

FIG. 4. FIG. 3



when they are placed upon charcoal and exposed to the blue, which is the hottest part of the flame—that is, fragments of those metals which do not require the oxyhydrogen blowpipe. When a very mild degree of heat is required, the object is removed further and further from the centre of the flame, sometimes, as in reducing the fluxes preparatory to soldering, to the stream of hot air beyond the tongue of the flame. Many artizans employ a large oil-lamp flame in soldering, the wick from a quarter to an inch in diameter, plentifully supplied with oil. In such case, the blowpipe is selected with a middling-sized orifice, blown vigorously, and held a little from the flame, so as to spread it in a broad stream over a large surface of the work, which is supported on charcoal. When a minute portion alone is to be heated, the pointed flame is used with a milder blast and a decreased distance. Fig. 3 is a Birmingham arrangement, used in cheap jewellery manufactories. A stream of air from a pair of bel-

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lows directs the gas flame down a shoot upon a flat disc of sheet iron fixed on a wooden handle, which disc is covered with a matting of fragments of wire beaten into a sheet, some of the bits turned down to hold on the disc. The work to be soldered is, as seen, placed on the wire, which becomes partially red hot, and retains the heat, though not so well as the charcoal, yet without the inconvenience of burning away and preserving a level surface, which is a great desideratum, very often, however, small cinders are placed on the disc, either upon, or instead of the wire. Occasionally, as in Fig. 4, the gas-

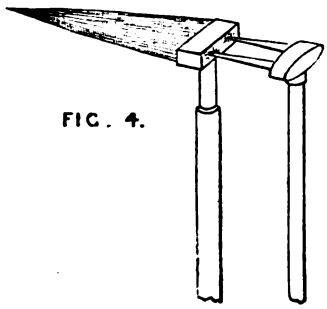
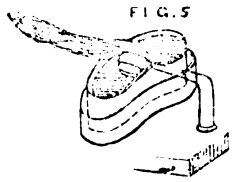


FIG. 4.

pipe is crowned with a head, with two blowpipes directed through. The makers of philosophical instruments very often use a table blowpipe, with a shallow lamp, as in Fig. 5. The wick must be plentifully supplied with tallow, and a furrow is made through it with a wire, to afford a free passage for the blast from the fixed nozzle. This lamp, by the way, has a loop placed lengthways upon the short diameter, for holding the cotton, which is sometimes an inch long, and half an inch wide. This lamp emits less smell, and is more cleanly than those supplied with oil, the fat being caught in the

FIG. 5



outer vessel. Many blowpipes have been invented for the employment of oxygen and hydrogen, one or two of which we will describe. The general form of the workshop blowpipes is that of tube open at the one end, and supported on trunnions in a wooden pedestal, so that it may be pointed at any angle, Common gas is supplied through the one trunnion, and escapes through an annular opening; whilst oxygen gas, or, more often, common air, is admitted through the other trunnion, and is discharged through a central conical tube, in the centre of the hydrogen—the size and intensity of the flame being regulated by the relative quantities of gas and air, and by the amount of protrusion of the inner core by which the annular space for the hydrogen is contracted in any required degree. Mr. Gill's portable blowpipe furnace may here be noticed as deserving of a corner. It consists of a lump of pumice-stone three or four inches in diameter, scooped out like a crucible: into this cavity small pieces of charcoal are placed—sometimes a perforated cover is added. The interior may be intensely ignited, whilst the outside, through the slow conducting power of the pumice stone, is not repulsive to handling.

(*To be continued.*)

THE ENGLISH MECHANIC.—HIS RISE AND PROGRESS.*

(*Continued from page* 124.)

I have spoken at some length upon the early history of the Institution of Civil Engineers, because, in the blaze of its present prosperity, the struggles and the difficulties of its early life are apt to be overlooked, and we who have scarcely yet surmounted parallel trials, are sometimes regarded as unlikely long to survive them. We have not yet, t is true, been transformed from the chrysalis of he tavern to the butterfly of the hall, but we have aith in the coming change. At any rate, we may raw a moral from the past of the institution to which reference has been made, and from its present flourishing condition take heart in our labours for the prosperity of our own.

Many other societies of equal eminence may trace their origin to the meeting of a few earnest men on the neutral ground of the tavern parlour, and it is scarcely fair towards this one to point the finger of scorn at it, because, as yet, its members assemble beneath the friendly roof of an inn.

I come now to a point in my rather crudely and imperfectly drawn sketch which I deem to be fraught with considerations of some moment, I allude to the future of the London Association of Foremen Engineers, and I must be allowed to say that if it is hoped that its onward progress may be rapid, our members generally must exert themselves much more than they have hitherto done. Few can estimate more exactly than the writer of this paper the anxious and responsible duties of a foreman engineer. I know that very frequently the cares of a harassing day are followed by the horrors of a sleepless night, during which the troubles of the morrow disturb the foreman's brain. I know that he has to rise early and leave his factory late, and that his intermediate occupations are often multifarious and difficult. All this I know, and much more of the foreman's ordinary life. Still it is my conviction that all may do something more towards forwarding the interests of their own association, and, in doing so, promote their own. It is astonishing what may be done by application, perseverance, and determination, and it would be possible to cite innumerable instances in our own profession in which the possession of those qualities have raised their owners to dignity, to honour, and to wealth. The biographies of scientific men teem with illustrations of the wondrous effects of the talismanic words just mentioned, and show those who have sought to rise

> Out of the prisons of their mean estate;
> And with such jewels as the exploring mind
> Brings from the cage of knowledge to buy their ransom,
> From those twin gaolers of the daring heart,
> Low birth and Iron Fortune,

have succeeded in effecting their release, and in rising to liberty and greatness. It is not given to every man to be great, but there are few who may not be useful to their fellow-men if they but seek the means.

I must remember that I am not in a pulpit, however much these remarks may resemble part of a sermon, and I will return at once to plain speaking It is my candid opinion, then, that each of the members of this Association should determine to read a paper, and do it Each has had his workshop schooling, and there is no reason why (in workshop language if he will) he should not impart some of the knowledge he has gained to his neighbours. There is not one who now listens who has not gained some special information—who has not his mechanical pet, who cannot bring forth from the recesses of his mind some favourite theory, or who is not able to deliver himself of an inventive thought. We have had industrial exhibitions in which the products—valuable, curious, or grotesque—of the leisure hours of working men have figured *ad libitum*. My desire is that here we should have constant exemplifications of the cogitations of our members in their leisure hours, details of experiences in their busy ones, or speculations on future mechanical improvements. There is around me a mine of intellectual and mental wealth—it only needs working; the ore will then soon appear, and the conversion of it to useful purposes will speedily follow. The press will not only stamp that ore with approbation, but give it speedy currency, and pass it along the channels of general circulation. It has been often said that we have very few papers read, and that we therefore scarcely deserve the appellation of a scientific society. Let us endeavour to remove the stigma. It is in the power of each of us to assist in the task, and the will alone is wanting. Let the coming year display greater activity on our part than that which is passing away, and beyond doubt the influence and dignity of the institution will be much enhanced by the process.

From close and constant observations of the feelings, with some knowledge of the habits, and with great confidence in the practical knowledge of the members of this association, I feel assured that short suggestive papers, provocative of discussion, are the most desirable, and these, fortunately, are within the reach of all. You have little time to spare, no doubt, but such as you have could not certainly be more profitably employed. Bring out, then, your hobbies, and let us examine their claims to that distinction. I say this in all earnestness, because the future well-being of the society depends largely upon self help. It is impossible to command respect, if no efforts be made to attain it. If the Association is to stand independent and erect among its fellows, it must be by the exertion of its own innate strength, and not by the mere resting and being thankful for what has been done. Dante said, a long time since, that

> He who beneath the coverlet reposes
> On bed of down, can ne'er arrive at fame;
> Without which, whosoever his life consumes,
> Leaves of himself the vestige on the earth,
> As smoke in air, or bubble in the wave.

What Dante said of old is eminently true at the present time, when competition, not in trade only, but in knowledge and intellectual achievements, is the watchword; and when those who eat the bread of indolence, except the privileged classes, will speedily find that bread very bitter and unpalatable, if, indeed, they obtain bread at all.

It has already been observed that we desire the friendship of employers, and I can imagine a period yet to come, when those gentlemen will attend in this our lecture room and studio, not for the purpose of teaching us how to govern the institution, but for that of imparting to us information which their superior position, and more fortunate circumstances, have enabled them to obtain. I can imagine a time yet to come, when in this arena of friendly discussion, wherein it is desired that all opinions on legitimate subjects may be freely and unreservedly expressed, the employers of engineering labour will take part in our deliberations; and thus, while communicating knowledge, themselves derive, both directly and indirectly, advantage. When that happy period shall have arrived, it is my opinion that this Association will have attained to something like the amount of usefulness of which it is capable. We shall then have employers inducing not only their foremen, but their managers—the latter a class whom it would be well if we saw more of at our meetings—to assemble at our council table, and thus to add to the prosperity of the association. We wish class feeling—that enemy to comfort—that foe to all that ennobles human nature—and of which, from having been twenty-five years in a Government establishment, I have a painful knowledge—should disappear for ever, and that the mere accident of varying rank should not interfere with individual respect. It is time that the petty but stinging annoyances to which men are sometimes subjected, because they work with their own hands, or because they once did so, were forgotten. For ourselves, we wish to discard class feeling from our vocabulary, and I trust have learned that a man is to be respected, not for his rank or his position, but for his attainments and his character—not because he has been more fortunate, but because he is morally and intellectually better than his neighbours. In such spirit have the laws of this institution been founded, and in such spirit are, and ever will be, those rules, I trust, acted upon. From the fact that the association was founded by foremen, for foremen's material and moral good, it is impossible for those who have not attained a foreman's place to become participators in all its privileges; but our doors are open to engineering workmen, and our papers may be listened to and discussed by them. Their presence, indeed, is desired; they are admitted on the simple introduction of members, and gladly would we see more of them present on such occasions as this. When more accommodation shall be at their disposal, when the Foremen's Hall which has been spoken of shall be obtained, no doubt the committee will extend the number of their invitations, and that Hall will be filled by representatives of every branch and every grade of the engineering profession. At present there is necessarily a limit to those invitations, simply because there is a limit to the accommodation to be offered to those who might accept them.

(*To be continued.*)

* A paper read by Mr Joseph Newton before the London Association of Foremen Engineers, November 4th, 1865.

THE PNEUMATIC DESPATCH TUBE.

The system of conveyance by atmospheric propulsion through a tube, which was lately exhibited in the grounds of the Crystal Palace, and had previously been tried on the short experimental line at Battersea, as well as in the neighbourhood of the Euston-square station, in Seymour-street and Eversholt-street, Camden-town, has now obtained an important practical extension by the opening of the line from Euston-square to Holborn—a distance of one mile and three quarters, whence it will be continued another mile eastward to the General Post Office, St. Martin's-le-Grand. The premises, No. 245, Holborn, which are the present terminus of the line, are well worthy of a visit of inspection.

Entering from the level of the street, the visitor passes along a corridor through a doorway, and emerges upon a gallery of considerable size, from

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which he looks down on a brick floor, supporting lines of rails, much as he might do from a railway platform down to the line, but from a greater elevation. Underneath the corridor by which he has just entered he sees some mechanical appliances, suggestive partly of an engine-room and partly of a pointsman's gallery outside a railway station; and below the level, again, on which the white-jacketed engineer in charge is standing, and supporting the platform on which both he and these mechanical appliances rest, are a couple of openings, looking like black, polished modern chimney-pieces with the grates withdrawn. These are the mouths of the pneumatic tubes, of which one communicates with the North-Western Railway; the other, idle at present, will soon be drawing in and delivering mail-bags from and to the postal head-quarters in London. The mouth of each tube is shut, when the tube is exhausted of air, by iron folding-doors, which meet, not evenly, but at an angle projecting outwards so as to resist the atmospheric pressure from without. These doors are made to fly open on the approach of the train, the bolt which closes them being withdrawn by the action of a spring lever, which underlies the rails, and gives way beneath the weight of the train. The carriages are shaped like a capital D turned over on its straight side, and mounted upon wheels. Each end of the carriage has a raised head, or flange, shaped so as to correspond with the interior of the tube, the dimensions of which are 4 feet in height by 4 feet 6 inches in width. Their ordinary freight is expected to be in the first instance letter-bags, then probably railway parcels, certain descriptions of market produce, and ultimately it may be general merchandise.

On the opening day the Duke of Buckingham, chairman of the Pneumatic Despatch Company, had invited a number of scientific gentlemen to inspect the apparatus. After the train had made some successful passages to and fro, several of the party expressed a strong desire to pass through the tube themselves. They were warned that the line was "not constructed with a view to passenger traffic," and that they might find the way "a little rough." The spirit of adventure, however, prompted them to take this strange journey, and each of the wagons had soon as many occupants as it could comfortably accommodate in the recumbent posture enforced by circumstances. Tarpaulin coverings were obtained for one or two of the carriages, but the greater number of the excursionists had to fit themselves in as best they could among the bags of shingle, which made up the temporary loading, taking care to keep their heads well below the edge of the carriages.

"The sensation at starting, and still more so upon arriving (say some of the passengers) was not agreeable. For about a quarter of a minute in each case there was a pressure upon the ears suggestive of diving-bell experience; a suction like that with which one is drawn under a wave, and a cold draught of wind upon the eyes, having almost the effect of falling water; but, once fairly within the tube, these sensations were got rid of, or left behind, and the motion had little more positive comfort about it than would be attendant on riding on a 'lorry' over the worst ballasted line in England." The air within the tube was by no means foul or disagreeable; here and there a strong flavour of rust was encountered, but this was explained by the fact that, as the tube had to be laid in lengths, through various soils, and encountered in the process a large share of unfavourable weather, the corrosion on the surface of the iron could not be expected wholly to disappear until cleared away by the friction of constantly passing and repassing trains. On the arrival of the excursionists at the upper or Euston-square extremity of the line, they quitted their places for a few moments to inspect the smaller tube, which communicates with the Eversholt-street district post-office, and then returned by the way they had come to Holborn.

No doubt remained on the mind of any person who witnessed the opening trip as to the facilities which the system, if a sufficient number of stations can be incorporated with it, is calculated to afford, not only to the postal service, but to the requirements of the general public. The scheme of the company, who, it seems, possess under their Act powers to lay down pneumatic tubes at any points within the jurisdiction of the Metropolitan Board of Works, is to construct similar lines to that now opened between the ten district post-offices and the General Post Office, and between the different railway termini and goods depot in London, connecting with these lines the six principal London markets and other important points. For these purposes it is calculated that some thirty-five miles of tubing and a capital of £1,250,000 will be required, the cost per mile, roughly estimated, being from £30,000 to £35,000. The expenditure of the company hitherto has been probably £150,000, which would be largely in excess of this supposed average; but the sum mentioned includes the cost of preliminary experiments, and also for seeking for two Acts of Parliament. The company expect that great profits will eventually accrue to them from the carriage of goods.

REVIEW.

(*Continued from page* 129.)

A Treatise on Gas Works, and the Practice of Manufacturing and Distributing Coal Gas. By Samuel Hughes, C.E.; Revised by W. Richards, C.E. London: Virtue, 1, Amen Corner, Paternoster-row.

The recent unfortunate explosion and consequent wreck at Nine Elms created a great fear in the metropolis, which was not allayed by certain daily journals stating that the city was at the mercy any day of the great gas-works. They are only at the mercy of the companies, so far as regards the quality and price of the article; and very likely the action of the Corporation in the next Session of Parliament may "break the charm and loose the spell." The following extracts from the chapter on explosions and accidents cannot prove other than interesting:—

"Explosion is an instantaneous ignition of a mass, and that mass may be solid or gaseous; thus, a mixture of charcoal, sulphur, and nitre in certain proportions, and prepared in a particular manner, forms gunpowder, which ignites instantaneously, and the increased volume, occasioned by the solid assuming the gaseous state, is the cause of the force or power attending the combustion. There are numerous other solid compounds even more explosive than gunpowder, but the simple mention of this will be sufficient as example.

"Certain gases, like the solids, when intermixed in due proportion, are likewise capable of instantaneous combustion; for instance, hydrogen when intermixed with oxygen, as before stated, in the proportion, by volume, of two of the former and one of the latter, ignites, producing explosion; and coal gas when combined with air in certain proportions is also explosive, this being due to the hydrogen and carbon composing it entering into combination with the oxygen of the atmosphere, producing water and carbonic acid gas; and the nearer they approach to the proper proportions for the perfect formation of these compounds, the greater is the force of explosion. A mixture of seven parts of air and one of gas is considered to be the most explosive compound, but this must depend on the quality of the gas. Mixtures of less than three of air to one of gas, or more than eleven of air and one of gas, do not explode.

"At one period or other, in some of the largest cities of the United Kingdom, as well as those of the Continent, gas-works have been the scenes of explosions. This has often arisen from a new gasholder, when nearly terminated and ready for use, having, from a very simple oversight, been communicated with the manufacturing apparatus; and it has afterwards happened that through a leaky valve allowing the gas to pass, or perhaps by some careless person thoughtlessly opening the valve, the gas has entered, intermixed with the air in the holder, and the accidental production of a light has caused the disaster. Therefore, when new holders are constructed they should either not be communicated with the manufacturing apparatus until quite terminated, or the pipes should be "logged," or sealed with water, so that no gas can possibly enter until quite ready for use.

"But explosions of this nature have occured when the holder was being first filled with gas; one of the most remarkable took place a few years ago, by which the engineer was killed. This arose from a defect in the construction, and want of ordinary caution on the part of the unfortunate sufferer. The facts are simple, for the holder on being charged with gas at the commencement of the operations contained a considerable quantity of air, the two forming an explosive compound, and by a singular fatality it happened that the holder was so far bound, or set, as not to give any pressure. The engineer being desirous of judging the quality of gas, very imprudently tried it at an open orifice of about ¼ inch diameter; the consequence was, the flaming entering, the explosive compound in the holder ignited, and produced the disaster. Had the gas been tried by an argand or fishtail burner the accident would not occurred, the holes in these being too small to permit the flame to enter.

"Explosions have taken place in station meters when newly erected, just previously to their use, this arising from causes already mentioned—by leaky valve, or by unnecessary meddling on the part of the workpeople. On one occasion which came under the writer's notice, a calamity of this kind occurred from the mixture taking fire through the men making the joint with overheated lead. And this suggests the varied opinions as to the possibility of a spark igniting gas. The general opinion is that gas cannot be ignited by that means; and, indeed, it is difficult to be done, but by chance a spark may be produced of sufficient heat to inflame gas.

"Accidents have frequently occurred when lying mains; often occasioned by bladder-valve, which has permitted a small portion of gas to pass into the main beyond it, where the explosive compound was formed, and by the merest hazard a neighbouring light has produced the calamity; therefore, in lying mains, when practicable it is always better to have a sheet iron temporary valve, which is done by having the spigots of two pipes together where the stoppage is desired, and a thin sheet of iron between them, which may be clayed or cemented round to prevent the leakage of gas. The plate can be removed when requisite, and a temporary or permanent joint made with a running socket.

"An erroneous impression exists that if a gasholder were to be rent by accident, and the gas ignited, whenever the holder touched the ground, and there being no pressure, that the contents would explode. This in incorrect, for, no matter the size of the opening, when the pressure ceased the gas would be extinguished; but from this moment danger would commence, for a portion of the gas remaining in the crown would gradually issue, and air take its place, so by degrees an explosive compound would be formed.

"An explosive compound of gas when under pressure only ignites at the exterior of the pipe; but if the pressure be taken off, the flame enters, and it explodes.

"An explosive mixture always possesses a very powerful odour of gas; this is sufficient to indicate to any one that a light should not be approached; and under these circumstances, when in dwellings, ordinary precautions only are requisite: above all to have no lights near, and to open the doors and windows, the upper part of the latter especially, as gas by its lightness ascends, and will readily escape thence. The main tap should be turned off, and a careful inspection made, when perhaps a burner will be found turned on, or an hydraulic joint without water, or some other defect which can easily be remedied. No one should ever apply a light where there is an odour of gas in the upper part of an apartment; many little mishaps have occurred through neglecting this precaution. Should there be any escape which can only be detected by flame, the gas ought to be turned off for two or three hours, and the other precautions being adopted, the light may be applied the moment the main tap is turned on; but it is always better and safer to detect escapes in dwellings without the employment of a flame, it requiring only a little more patience.

"Meters are sometimes mysteriously destroyed by explosion, even when fixed in their places. The syphon plug when not sealed by water, and the tap of a burner being left open, are sufficient to permit air to enter and form the explosive compound, and a light being applied to an orifice without a burner, the flame enters, but does no injury beyond rendering the meter useless.

"Of the few explosions that have occurred in gas-works, the majority have arisen from having the pipes in vaults and tunnels, or perhaps from open spaces existing under some of the apparatus, generally with the view of seeing to the perfect condition of the pipes, &c. From this originated the first two accidents of the kind, which befell Mr. Clegg, forming a very powerful argument against the use of subways, proposed some time ago, for containing gas mains; and if these were unfortunately to be carried into operation, all the extravagant fears of danger which existed at the introduction of gas would certainly be realised.

"On the occasion of a fire occuring near gas-works, the public journals generally fall into error by assuming the contents of the gasholders to be explosive, and conjecture the amount of damage that would arise from this event occurring, the excitement being much increased by this mis-statement. Gasholders when in use, that is, containi g ordinary gas, cannot by any means explode, even although the plates forming them were to be made red-hot by the flames: all that could occur is that the gas, expanded by the heat, would issue in detached flames, but no explosion could take place. Another common error, when an edifice, as a theatre, takes fire, is to turn off the gas to prevent explosion, and this is done sometimes at the risk of putting the audience in darkness to find their way out in the best manner they can. Nothing is more absurd; for supposing, at the worst, the fire

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to melt the pipes in the building, and the gas to issue, the same flame which melted the pipe would ignite the gas, so that explosion is not possible under these conditions. A good system is to have a valve or valves on the exterior of all public buildings of resort, which, in the event of a fire unfortunately occurring, can be shut off after all the people have left the building, so preventing the destructive effects of the flame should the gas ignite, and the loss of gas."

But here we must call a halt. There is something in this wonderfully cheap volume for everybody, and everything for the person interested in gas making and selling. At no more opportune moment than the present could this edition have made its appearance; it reflects equal credit on its author, editor, publisher, and printer; and we trust its sale will be so extensive as that in a short time no man of any intelligence can be found ignorant on the subject of gas.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

T. A. COTCHETT.—Thanks for your kindness.

JAMIED.—You had better not try the experiment.

DAVID KNIGHT.—Will appear, if possible, next week; but we are terribly crowded just now.

J. B. P.—Write to Spon, Bicklersbury.

R. D.—Watch for answers to W. Sale.

BIRMINGHAM.—Mr. Tonkes may comply with your wishes. Send your address to us in an envelope, and Mr. Tonkes will receive it.

R. HOLBROOK.—Of Edgeley, Engineer, Lamb's Conduit-street, Bloomsbury.

J. S.—Evidently a printer's blunder. We regret that it occurred.

G. WATSON.—In a future number.

E. VINES.—Will receive attention.

H. W. M.—Write to Virtue, Amen Corner, Paternoster-row.

ROBERT THOMPSON (Oldham).—The lathe was patented in 1863, by E. H. Wisel, of Warren, Ohio, United States. You can obtain any information you require through Munn and Co., Patent Agents, New York, U. S.

COATING BRASS AND COPPER WITH TIN.—The address of our correspondent who wrote on this subject in May last is required by A. W.

A YOUNG PLASTERER.—Explain yourself more clearly.

W. H. H.—We have complied with your request this time, but we cannot spare space for tradesmen's addresses.

C. SIMPKINS.—Apply to Mr. Rimmel, Perfumer, West Strand, London.

Mr. ——— LONSDALL.—We are sorry to say that we cannot obtain the address.

E. J. WITCHELL.—Unable to engrave this week—perhaps next.

WILLIAM COOPER.—Received, but far too lengthy for insertion.

F. MASON.—See reply in number for December 5. If still dissatisfied, write again.

A WORKING APPRENTICE.—You had better serve your full time, and receive your indentures endorsed favourable to your character and craftsmanlike perseverance.

WOODEN HEAD.—We advise you to search through the back numbers. Many letters and engravings have appeared.

W. SALE.—The experiment has yet to be made in a small way.

W. E. S.—We are going to look at a new boiler, which we are informed is somewhat on the same plan. We will then give opinion.

F. H. COLLINS.—Published by Munn and Co., Patent Agents, New York, U. S.; London agents, Sampson, Low, and Co., Ludgate-hill. A quarter's payment in advance. Receive the paper four weeks after payment.

W. C. C.—You can purchase a flexible one of Bailey and Co, 418, Oxford-street. The price will depend upon workmanship and trouble in fitting.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

AVENTURINE.

Venice has long been celebrated for its beautiful imitation of aventurine; but the material it furnishes to the lapidary has been far exceeded in every respect by a compound recently discovered by Pelouze. The real aventurine is a variety of quartz, containing throughout its mass minute spangles of mica. The imitation obtained from the glass-works of Venice is a glass, coloured by oxide of iron, and having diffused through it crystals of metallic copper its composition remained a secret, until discovered by MM. Fremy and Clemandot. They found that it may be formed by fusing together, and keeping at a high temperature for twelve hours, a mixture consisting of 800 parts pounded glass, 40 parts protoxide of copper, and 80 parts oxide of iron, and then allowing the mass to cool gradually.

During his experiments, M. Pelouze observed that, not only sesquioxide of chromium, but also bichromate of potash, communicates a green colour to vitreous compounds: the bichromate being decomposed by heat into oxide of chromium and neutral chromate of potash: which latter is decomposed by the silex, oxygen silicate of potash and oxide of chromium being the result. If the oxide of chromium thus produced is small in quantity, the glass is perfectly transparent, and of a light green tint; if, to a certain extent, large in quantity, very brilliant spangles of sesquioxide of chromium are diffused through the glass. Using always 250 parts fine sand, 100 parts carbonate of soda, and 50 parts carbonate of lime, he made experiments with various amounts of the bichromate of potash, but found that the best proportion for it was 40 parts. This compound is somewhat difficult of fusion, but is far more easily prepared than that of Venice. It is filled with extremely brilliant crystals, and in strong light yield only to the diamond in splendour; it is worked with ease, though much harder than the aventurine of Venice. It has been termed *chrome aventurine*. The spangles have a decided tendency to the form of an irregular hexagon, belonging to the same system as the sesquioxide of chromium; and they resemble certain varieties of olegist iron, with which, indeed, sesquioxide of chromium is isomorphous, and especially with that species termed *specular*. The colour of the Venetian aventurine is brown; that of the new kind, a beautiful yellowish green, which is much finer. It takes a high polish, and is not liable to be scratched, and thus lose its lustre, as it is so hard that it will cut glass.

GENERAL NOTES.

ELECTRICITY AS A MEANS OF TAKING CORRECT SOUNDINGS IN DEEP WATERS.—In taking deep-sea soundings, the great difficulty is to determine the exact moment at which the lead touches the bottom. Several very ingenious contrivances for overcoming this difficulty have been devised of late years, but none of them have proved so successful as one which has just been suggested by M. Hedouin of Lyons, seems to promise to be. M. Hedouin proposes that the sounding line should be a kind of light telegraph cable, enclosing two carefully insulated wires, both connected, at one end, with the lead, and at the other with the two poles respectively of a voltaic battery, and that the lead should be so constructed that on touching the bottom it should make metallic contact between the extremities of these two wires, and thereby cause the instant passage of an electric current. It is obvious that this current could be made either simply to give warning, by ringing a bell or otherwise, of the lead having touched the bottom, or to put in action an automatic brake, and so prevent any more line passing into the water.—*Mechanics' Magazine.*

THE BESSEMER PROCESS BY GAS.—Last week an influential company assembled at the new works of the Mersey Steel and Iron Company, at Liverpool, to witness some interesting experiment with this new process. There are two furnaces capable of receiving ten tons of metal each. In one of these, which is heated by gas, the iron is first melted, and in the adjoining one a composition of manganese is also melted. The two molten liquids are then run into a hugh crucible, through which a blast is forced by two engines, of 100 horse-power each, and the combustion then clears the mixed metal from all impurities, and transforms it into cast-steel, in which condition it is finally run into ingot moulds. The experiments were entirely successful, and were witnessed by several influential gentlemen.

THE COPPER SMOKE QUESTION.—It is well known that the utilisation of copper smoke has attracted great attention of late years, and only a few weeks ago particulars of a German invention in course of adoption at Messrs. Vivian and Sons works, Swansea, were given in the *Times*. Mr. H. H. Vivian, M.P., announced at a public meeting since held that he had every confidence in the success of the invention, and that in a short time the copper smoke from his works, which had been so injurious to the land around, would not only be rendered innoxious, but of great commercial value, by condensing it through various processes to sulphuric acid. Within the last few weeks Mr. Thomas Bell has brought forward another invention, which, since his letters in the *Times*, has attracted considerable attention. That gentleman has visited Swansea, the seat of the copper smelting trade, and he was introduced to the copper smelters at the last ticketing meeting, when he laid his plans before the parties then present, and he was invited to visit several of the principal local establishments in order to test the invention. From these facts it is inferred that before long the injury caused by the copper smoke will not only be neutralized, but the smelters will reap a handsome return from its utilization.

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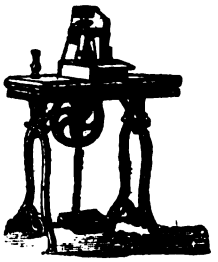

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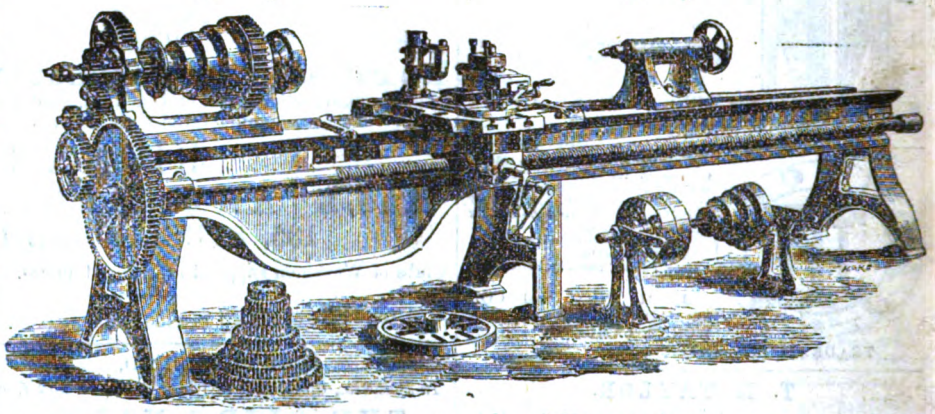

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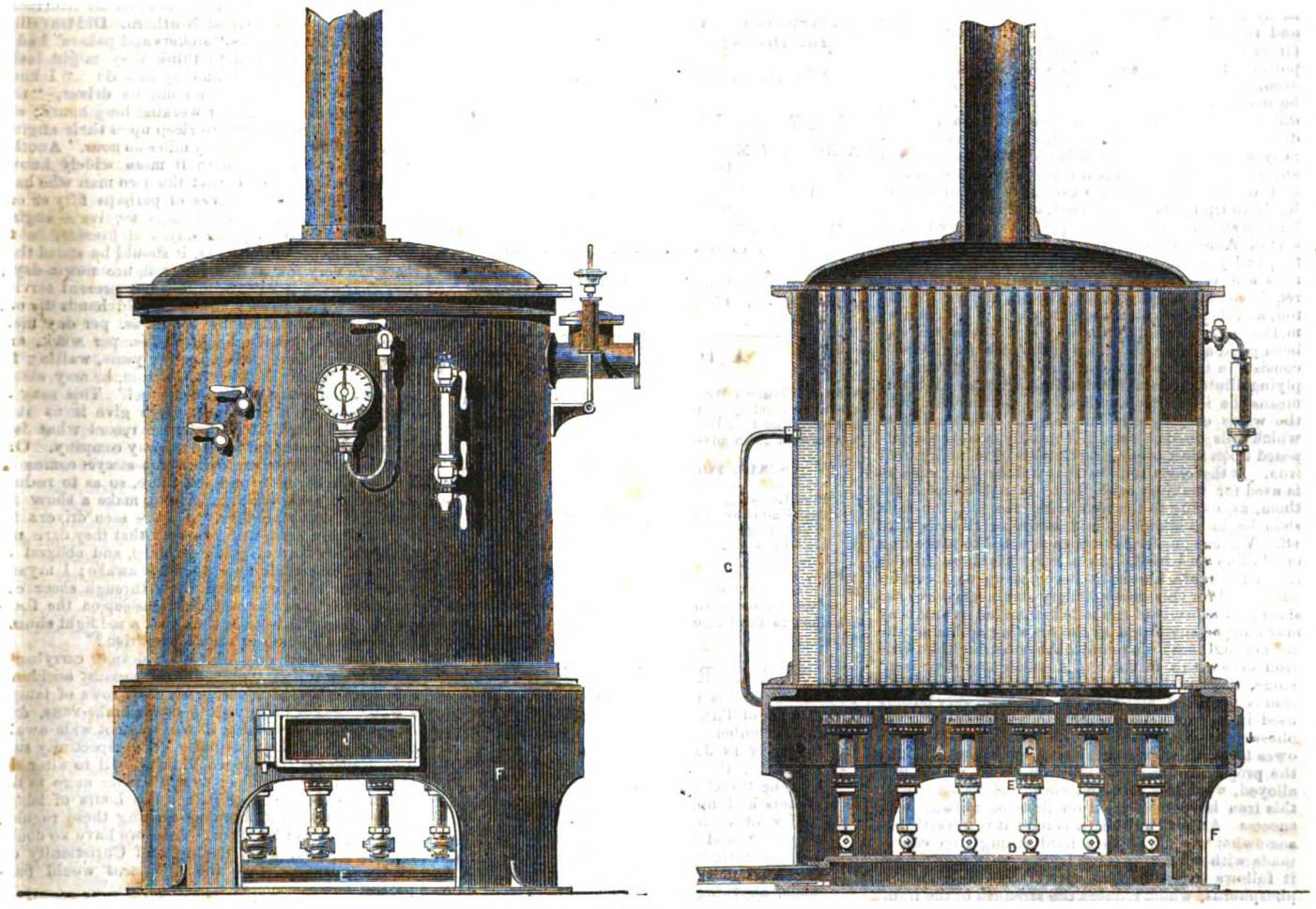

GENERATION OF STEAM POWER BY GAS HEAT. (JACKSON'S PATENT.)

WE present our readers this week with diagrams of a boiler heated by gas. The application of gas for such purposes is the patent of Mr. Arthur Jackson, of 26, Philpot-lane, City. The advantages of this source of heat are necessarily very great, as all dirt and smoke are avoided, the expenses of stoker and carting of coal and refuse saved, and the furnace is kindled or extinguished instantaneously.

The boiler represented in our drawings is of four horse power, and is fixed without any brickwork or chimney. When the engine is in full work the maximum expenditure of gas is guaranteed for the indicated horse power, and when it is not the consumption can be instantly reduced.

This plan offers great facilities for introducing steam power into warehouses and small manufactories, from the little space required, and from the absence of all danger of fire. It has been approved of by the Warehouse and Wharf Committee of the London Fire Offices, and by their surveyor, Charles Freeman, Esq., and with ordinary precaution can be generally adopted without incurring any additional premium.

A, gas furnace; B, gas chamber; C, gas burners with clay discs on surface; D, cock; E, valve for admission of air; F, pedestal containing furnace and supporting boiler; G, tube for circulation of water; H, water line; J, furnace door, which being of glass or mica, the furnace can be inspected without opening, and the gas regulated either by the separate cocks D,D, which are all outside, or by the main cock, thereby avoiding the admission of cold air.

Mr Thomas Middleton, of Loman-street Works, Southwark, is the appointed manufacturer.

TREATMENT OF IRON FOR RAILS.*

The chemical composition of iron undoubtedly exercises a considerable influence upon the character of the ultimate produce, and too much consideration cannot be given to its constituents. But there is yet another point to which an equal amount of attention is necessary, and this is the mechanical treatment of the metal. This is an important point, and one quite irrespective of chemical components. The general practice in Wales is to use the ordinary squeezer, although in some works a patent squeezer, consisting of three groved eccentric rollers, is used, and this is certainly a preferable machine to the other. The compression of iron is otherwise mechanically effected by the old tilt hammer and the steam hammer. At one time the tilt hammer was the only means of compression used, but since the furnaces have been driven, and forge and finery cinders and impure ores have been used, an inferior iron has been made, which will not stand the old tilt, and so the squeezer was introduced. By this instrument almost anything can be shingled into a bloom and passed through the rolls, whereas, with the old tilt, the iron, from first to last, has to bear the full weight of the blow. With the steam hammer, however, the case is different, as the blow can be regulated to any nicety. Specifications for rails frequently contain the stipulation that the iron shall be hammered, and not squeezed, and the plan has been adopted of doubling the puddle balls by slightly hammering them, placing them one on the other, and welding them into a slab for the head of the rail. By this arrangement the rail head is made crystalline and not fibrous, as it is only submitted once to the drawing action of the rolls. After being squeezed or hammered, the iron is passed through the rolls, and leaves them as No. 1 iron or puddle bar, which is cut by shears into the lengths necessary for the subsequent pile. There are different

* Extracted from the *Mechanic's Magazine*.

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methods of making the various piles for rails, &c., the great object in piling being to get the pile as solid as possible, and free from interstices. Piles are frequently made of puddle bar of different widths, piled alternately so as to break joint. In some instances the puddle bar is cut into short lengths, equal to the width of the pile, and each layer piled at right angles to the previous one. The object of this arrangement is to make the iron less fibrous, and it certainly has that tendency.

There are various sections of rail in use, but the three most general are the double-headed rail, the bridge rail, and the American or contractors' rail. The double-headed rail is generally made with slabs at the top and bottom of the rail; which for the best quality of rails are about 2in. in thickness, and the rails are double-heated. In some instances these rails are made of three hammered slabs piled on each other. In rolling the American, or flange-rail, as it is also called, a particular description of cold short iron is made for the flanges to stand the strain that necessarily arises from the rails being rolled edgeways, and the flanges not travelling at the same speed (from the less periphery of the rails) lest the flange portion of the rail also should slip. Partially on this account, then, and partially on account of the flange becoming colder than the mass of the rail, it is difficult to obtain a perfect flange unless a peculiar description of iron is used. This iron is made generally with forge cinders and Welsh ironstone without any red ore. The bridge rail is rolled flat—head up and down—and in this example the iron is only likely to rip by becoming cold, and is submitted to far less strain than in the flange rail. In the common sort of American rails the slabs for the heads are frequently made not more than ¾in. thick, and the rails are only single-heated. Single-heated rails require on an average about 12 cwt. of coals to the ton, and double-heated about 16 cwt. The readiest method of ascertaining the way in which a rail has been piled and the thickness of top slab for the head consists in filing a section of the rail smooth and applying dilute mineral acid to the surface. By this means the iron becomes dissolved and the cinder in the welds or joints is left intact. The strains to which rails are subject differ greatly from those imposed upon most other descriptions of manufactured iron. It therefore follows that fibrous iron, such as is used for making cable bolt, is not adapted for them, as, owing to the iron being too soft, the rails soon begin to laminate, and strips or ribbons pare off. Various means have been adopted to make iron crystalline and hard. As a rule, the more iron is rolled the more fibrous it becomes up to a certain point, and for this reason many engineers have the slabs for the heads of the rails hammered so that they may only be submitted to the drawing action of the rolls once. It has been found that by smelting the oolitic iron ores with a mixture of a cinder and clay ironstone, a peculiar description of cold short crystallized iron is produced, and this iron has been very largely used in the manufacture of heads of rails. To the phosphorus accompanying the oolitic ores this iron owes its peculiar characteristics; phosphorus having the property of making the iron, with which it is alloyed, work soft and cold short. Rails made with this iron have been used on lines of railway with success. Although this iron is hard it is nevertheless somewhat weak, and as a hard strong iron can be made with equal advantage by the use of manganese, it follows that this is a preferable ingredient to phosphorus, which reduces the strength of the iron.

GAS REGULATOR.

A very large item in the working expenses of our railway companies is made up of the charge for lighting by gas at the stations, warehouses, and offices. A few days since we had an opportunity of inspecting a very simple, but very efficient apparatus, by which a saving of at least 10 per cent. in the consumption of gas may be certainly effected. The instrument consists of a self-acting regulator, by which the pressure of the gas is made to act directly on a moveable drum, which, just as it is raised or depressed by the pressure, regulates the quantity delivered for consumption. The plan is so exceedingly simple, so inexpensive, and so little liable to get out of order, that it can be applied with great facility by any consumers of gas, whether in large or small quantities. The Great Northern Railway has already adopted the invention very extensively, and have found good reason to be thoroughly satisfied with the result obtained. The apparatus may be seen in action at Mr. Hulett's, gasfitter, of Holborn. We may add that it may be fitted to any meter without difficulty, and, as we have said already, it not only regulates, but very considerably economises the consumption of gas.

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OUR CHRISTMAS NUMBER.

In announcing his intention to publish an enlarged Edition of THE ENGLISH MECHANIC as a Christmas Number, TO BE ISSUED ON THE FIRST TUESDAY IN JANUARY, WITHOUT ANY INCREASE IN PRICE, the Proprietor respectfully submits that he thereby affords the many thousands of readers and numerous contributors an opportunity of each contributing a something as a Christmas and New Year's Treat for his fellows—some little "trick of trade" (in the good and true sense of the word); some improvement in tools, anything, in fact, which may be of value to brother workmen, and will assist in the promotion of feelings of kindliness and good fellowship, which the season is so eminently calculated to call forth. The Editor will not fail on his part, and will be glad to find a hearty response to this challenge to do mutual good.

The English Mechanic.

FRIDAY, DECEMBER 22ND, 1865.

"MUCH WORK AND LITTLE PAY."

THE letter in our journal the other day under this heading has called forth a whole batch from various "stokers and pokers." One correspondent says, "I suppose 'Old Clerk' means that, were the telegraph clerks to strike, a very great commercial panic would ensue. What would be the effect of a strike among the railway engine drivers and firemen throughout the country?" This query calls our attention to the consideration that there is a possibility of such a thing coming to pass. Many years ago—1850, we think—there was a strike among the men employed on the North British line running into Edinburgh, when the first victims to the cheap labourites were a whole truckful of beautiful pigs! In the Autumn of that year we encountered some dozen of the North British "strikers" in New York, on their way to various eligible situations. Now, were the men to determine on some such a step, we are not aware that they have not right and reason on their side—if there be any of the latter appertaining to the last resort. Folks are kicking at having to work ten hours a day; what would they say at having to work upon an average fifteen, and occasionally eighteen to twenty-one hours, as our railway friends do? And there have been times when these men have gone on for from forty-five to forty-seven hours. At the present time there are, we are told, trains running out of York which, under ordinary circumstances (a "good trip"), require the men to be seventeen or eighteen hours on duty, exposed to all weathers; and North Eastern men, it is affirmed, are exposed to rougher weather than any other men in the kingdom, owing to a little lack of humanity—covering the foot-plate, on Mr Sturrock's plan, adopted on the Great Northern. Did travellers know of the long hours "stokers and pokers" had to work, we are inclined to think they might feel a little more trepidation than they now do. "I know from experience," writes an engine driver, "that men get unwatchful, after working long hours; and men have been known to sleep upon their engines when running at forty or fifty miles an hour." Another one says, "I should wish it more widely known than in their own circle that the two men who have under their charge the lives of perhaps fifty or one hundred of their fellow beings receive — engine drivers, 4s. 6d. to 7s. per day, and firemen, 3s. to 3s. 6d. Respecting drivers, it should be stated that there are very few at the latter figure now-a-days, they that have it have been in their present service perhaps twenty years; and as the old hands die off, their places are filled by 5s. or 6s. per day men. Further, the firemen begin at 15s. per week, and after having been firing for ten years, waiting for the engine which is never given him, he may attain to 3s. 6d. for a day of fifteen hours!" This may be overstated, or it may not. We give it as it is given; and yet, if it be true, we record what is a disgrace and a shame to any railway company. One man says, "whenever a new top-sawyer comes on he lops off 3d. here and 3d. there, so as to reduce the cost of each train mile, and make a show for himself." Says another, "I have seen drivers for whom I have been firing so beat that they dare not sit down for fear of going to sleep, and obliged to keep bathing their eyes to keep awake; I myself have been so overworked that, through sheer exhaustion, I have dropped down asleep on the foot-plate. Can you wonder then that a red light should be run past by men in such a condition?"

We know perfectly well that, despite carrying a whole train full of "preventives" against accidents—lockers full of detonating signals, rows of lamps, a whole peal of bells, half a dozen brake-vans, &c., &c.—they are as nothing if we have not wide-awake intelligence on the foot-plate. We respectfully suggest, therefore, that it would be as well to alter the existing state of things; to add a trifle more to the running expenses, and reduce the hours of labour for both driver and fireman—making these regular, either by day or by night. And, we have no doubt, leaving justice, good feeling, and Christianity out of the question, that the *investment* would be a paying one.

ON THE ENGINEER'S SLIDE RULE.*

(Concluded from page 135.)

The next portion of the table of gauge points is intended for finding the areas of those regular figures which have from five to twelve sides, and which are generally termed polygons. Of these, the hexagon and octagon, having respectively six and eight sides, are most familiar to mechanics, and though a case would rarely occur in which their measurement would be necessary, it is as well to know something about them. The gauge points given on the rule are the areas of each of the figures when the side is one in length, and since the areas of all similar figures are to each other as the *squares* of the like sides, it is evident that the lines C and D must determine all questions relative to these figures, hence the rule becomes:—

Set the gauge point of the given figure on C to 10 on D, and against the length of the side on D is the area on C. Thus, required the area of a pentagon, the side of which is six inches. Set 1·72 on C to 10 on D, and against 6 on D, is 61·9 square inches on C.

A still more important, because more generally used figure, the circle, is next brought under con-

* Contributed by Mr. W. Tonkes.

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sideration, and on the rule six gauge points are given for finding the properties of this figure, and the relation it bears to the square.

1st. The area. The gauge point is here ·7854, because when the diameter of a circle is one, its area is nearly ·7854, and for the same reason as that assigned when treating of polygons, viz. :—that the areas of all similar plane figures are to each other in the duplicate ratio of their like slides, it follows that the lines C and D must also be used for finding the areas of circles, hence the rule becomes—

Set ·7854 upon C to 1 or 10 upon D, and against any diameter upon D is the area upon C.

2nd. When the circumference is one, the area of a circle is ·0795, consequently, when the circumference is known and the area sought, we take ·0795 as a gauge point, and proceed as in the last case.

3rd. It is well known that if the diameter of a circle is one, the circumference will be very nearly 3·1416, and this number therefore forms the gauge point when the diameter is given to find the circumference, and as the case simply involves multiplication, the lines A and B only are used, and the rule is set 3·1416 upon A to 1 upon B, and against any diameter upon B, will be found the circumference upon A. It is also known that the ratio 7 : 22 represents very nearly the ratio of the diameter to the circumference ; hence the same results will be obtained if we work by the rule given for proportion, viz:—

Set 22 on A to 7 on B, then against any diameter on B is the circumference on A.

This method is preferable to the former, because 7 and 22 are whole numbers, and consisting only of one and two figures are more readily found, and the slide more easily and accurately set than with the gauge point 3·1416.

4th. If we wish to find the side of a square equal in area to a given circle, it has been shown that ·7854 is the area of a circle when the diameter is one, and hence the square root of ·7854 would be the side of the square sought, if the diameter was unity, and this root, viz: ·886, is consequently the gauge point required in this case, if therefore, we set 1 on A to ·886 upon B, then against any diameter upon A is the side of the square upon B.

5th It can be shown that the greatest square that can be inscribed in a circle, the diameter of which is unity, has its side equal to $N\frac{1}{2}$=·707 nearly, hence this number becomes the gauge point when the greatest square that can be inscribed in any circle is sought, and the case becomes one of simple multiplication as the preceding is, but for some reason not explained. Mr. Routledge, and, I believe, all who have made his rules gives the reciprocal of this number, viz :—1·4142 as the gauge point on the rule, while they give the correct number 707 in the book of instructions. The difference in manipulation will be, that if we take ·707 it must be found on B, and placed against 1 on A, but if we take 1·4142 it must be found on A, and placed against 1 on B, in either case against any diameter on A will be found the side required on B.

6th and last, To find the side of an equilateral triangle inscribed in a given circle. This, where the diameter is 1, can easily be proved=$\frac{1}{2}\sqrt{3}$= ·866, and here again we find the reciprocal=1·15 substituted on the rule as the gauge point, requiring the same change in the mode of operating as indicated in the last case.

The remaining portion of the table of gauge points marked on the rule is for the purpose of finding the diameters of cylinders of steam engines capable of working pumps of variable diameters and depths.

This table was evidently formed when the steam engine was in its infancy and its energies directed principally to the drainage of mines, since it deals only with the earliest productions of Watts' genius, the atmospheric engine with balanced beam and 7lbs. pressure of steam, as a motive power, a simple pair of scales with alternately preponderating weights placed in the pans.

I might with good grace have omitted entering into a definition of this portion of the subject, but as I should thereby have left one portion of the slide rule unexplained, I preferred investigating it, in order to show that although modern improvements have rendered this table practically useless, this circumstance does not for a moment derrogate from the almost infinite applicability of the simple instrument under consideration.

The gauge points in the table represent the weight of water contained in a cylinder of any of the diameters specified, and one yard long, divided by the pressure intended to be applied to the piston of the engine that is to raise it, and since this pressure is considered constant, viz.—7lbs per square inch, it follows that if we multiply the gauge point by the depth of the pump in yards, the square root of the product will give the diameter of the cylinder required ; or, set the gauge point on A to 1 on B, and against the depth in yards on C, is the diameter of cylinder upon D.

So far my remarks have been strictly confined to the engineer's slide rule, but there is another somewhat resembling it, very often used by mechanics, generally known as the "Carpenter's slide rule," from the fact that nearly all the gauge points marked upon it are intended for the measurement of timber.

On this rule the line D is numbered from 4 to 40 instead of from 1 to 10, hence in calculating by it, as the lines C and D have the ratio of the square to it, not to each other, so the gauge points previously given must vary proportionately, hence to make the table of gauge points on the engineer's rule applicable to the carpenter's rule they must be multiplied by the square of $\frac{1}{4}$=1-16=·0625, and with a table so formed, all the foregoing operations can be as readily performed with one rule as with the other.

Wm. Tonkes.

THE ENGLISH MECHANIC.—HIS RISE AND PROGRESS.*

(*Concluded from page* 140.)

On some occasions invidious comparisons have been instituted between this Society and others of a cognate character, which have come into existence since the birth of our own. It has been said that those societies, though younger, have greater numerical strength. I have only to urge in reply to this, that the growth of an institution, the ordinary membership of which is positively limited by the qualification of holding a particular part for a particular period—in our case that of foremanship for two years prior to candidature—the growth of such an institution must of necessity be slow. We cannot gather fruit where none is growing, and foremen engineers of two years' standing are by no means as plentiful as blackberries in September. Other circumstances might be taken into account in this case, but it is scarcely requisite to enumerate them. It is sufficient to say that if our growth has been slow—as with a tree grown on rocky soil—there is toughness and strength in our texture, our fibres are closely knit, and no slight gale will even shake the fabric which it has taken twelve years to rear, much less to destroy it. Comparisons, however, are generally disagreeable, and they are especially so in this instance, where they have been based on imperfect data. The societies to which reference has been made, for which I entertain much respect, and which are effecting a great amount of intellectual good for their members, rest on a base totally different to ours. They appeal to a large and comparatively indiscriminate section of the engineering community, and consequently have a far wider field of operations open to them. They have not the concrete foundation of philanthropy and science to support their superstructure, as we have; they confer no directly material benefit upon associates as we do; and, in short, there are few points upon which fair comparisons may be instituted at all between their characteristics and those of this society. They have their influences—let us hope that our own exertions have not been destitute of that valuable characteristic. There can be no jealousy between us and them. If the number of their members increases with more rapidity than that of this association, so much the better for them, but certainly none the worse is it for us. Those societies are co-workers, not rivals, and cannot be regarded in any other light. In their success, therefore, we rejoice, assured as we are that the whole of the engineering community must benefit by their labours.

I should not have touched upon this subject at all but that others have in a measure compelled me to do so by their rather sharp criticisms of the proceedings of the Associated Foremen. Criticisms, when not ill-natured, are not unwholesome. It is well to have a friend, or even an enemy, candid enough to point out real or imaginary faults; it incites to self-examination, and results frequently in self-improvement. Let us, then, endeavour to profit by looking into the critic's mirror, and tracing on its bright surface any defects which may mar our features, endeavour to correct them, not by the use of flattering cosmetics, but by inward purification—which is more lasting and much more satisfactory in its effects.

I fear that my remarks this evening may seem desultory, and, to some extent, apart from my subject. If they are so, and become tiresome, I must throw myself on the generosity of my listeners. As in the theatrical world an actor of very moderate ability sometimes is obliged to undertake a part "at very short notice," and which should have been played by a more distinguished man, so have I on this occasion undertaken to play a part for which I was unprepared, and to occupy the place of a much more eminent actor.

It might have been expected that I should have produced some statistical information in regard to the association, but there were two reasons against that course: the first, lack of time; the second, because it was imagined that it would be better to reserve them for the ensuing anniversary, as a more fitting occasion for their production. If I am asked why I ventured upon such a theme at all as that of ourselves and our own institution, I am unable to answer the question, except by saying that no other presented itself capable of being dealt with in the limited time at my disposal; and even this has been but the more imperfectly treated from lack of time. It would have been possible to have reviewed the progress—the incredible progress—which has been made in engineering, and in the mechanical arts in this country during the last few years, and to have shown that much of that progress is due to the untiring but unobtrusive exertions of foremen engineers. The wondrous extension of the railway system, which is transforming every feature of the metropolis—and in some cases, it must be admitted, not improving those features—might have been expatiated upon. The re-construction of our steam navy, and the conversion of engineers into ship-builders and artillerists, might have been legitimately alluded to, for in these changes the foreman engineer has played no inconsiderable part. These and many other questions might have been appropriately enough embraced in the subject of this paper had it fallen into abler hands, or had more time been at the disposal of the writer. I have only, as it were, skimmed the surface of the water, and left its depths unsounded, its bed unmapped.

Great, however, as has been the labour and the usefulness of the foreman of the past, much more will be required of him in the future. The development of every branch of mechanical industry on the Continent, the vast improvement in the quality of foreign workmanship, and the removal, on our parts at least, of all commercial restrictions, bring the mechanic and the artizan of this country face to face with a competition keen in its nature and excessive in its proportions. It is only by a combination of superior circumstances that we can hope to stem the opposing tide. Those circumstances are, to a great extent, within our own control. There must be a complete understanding between the employer and the employed. It is the duty of the first to remove every real disability under which the workman labours, and it is the duty of the latter to co-operate cordially with his master in his attempts to achieve excellence and to maintain the fame of English operative art. The intermediate agent has a yet more difficult task before him. The foreman must so comport himself as to obtain and preserve the confidence of both master and workman, and to direct the skill of the subordinate into the most efficient and economical channels. In order to effect this, he must make himself yet more completely competent in the knowledge of his profession, yet more zealous in his intellectual studies, and yet more determined to keep pace in the onward march of mechanical discovery. By such means, and by such means only, can England hope to hold her own in the competitive struggle for manufacturing supremacy which is daily becoming more intensified and more obstinate.

It is the mission of such associations as our own to assist in this important work. In these miniature scientific parliaments debates on mechanical problems, engineering practice and theory, and on new inventions and discoveries, are the staple material which we have to seek for and to encourage. I, for one, have full faith in the success of the mission of such societies It is practically impossible for foremen to attend their meetings without becoming in all ways better qualified for the performance of their especial duties, and more considerate controllers of the work-people under their direction. On all hands, then, and for every reason, associations like our own demand countenance and support; but when each member shall exert himself in the way indicated, this association, I am assured, will obtain both. Let us, therefore, while admitting the impossibility of commanding success, do more—let us deserve it.

My self-imposed task now approaches its termination, and probably you are not sorry that it does so. Like many other tasks I have undertaken in my time, it does not, when completed, satisfy myself. The execution has fallen far short of the conception; and probably I may, with some justice, be charged with lecturing my brother-members instead of delivering to

* A paper read by Mr. Joseph Newton before the London Association of Foremen Engineers, November 4th, 1865.

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them a lecture. You will at least, I know from past experience, be generous enough to give me credit for good intentions, and to pardon my failure in this case to realise them. It seemed to me that it was not an improper thing to "take stock" as it were of ourselves and our association, and to endeavour thus to arrive at an approximate estimate of our own position and its usefulness. Were our society of no more service than to make individuals in similar positions, with similar cares and anxieties, labouring under similar difficulties, and pleased by similar circumstances, personally acquainted with each other, and personally interested in each other's welfare, it would be entitled to commendation; but, as I have endeavoured to show, it does much more than this. The London Association of Foremen Engineers is a moral and intellectual lever which, properly applied, cannot fail to elevate its members, and to place them on an eminence far higher than that attained by non-associates, and thus to increase not only their own self-respect, but the esteem in which they are held by the world at large. I need not say to its own members that it essays also to relieve the pressure of their physical ills, to provide for them a solace when the lamp of life grows dim, and to comfort their families when that lamp is extinguished. It is well that these latter characteristics adorn the society, for one cannot, as an old writer has said, help putting little trust in the friendship of the world:—"When I see leaves drop from their trees, just such, think I, is the friendship of the world. While the sap of maintenance lasts my friends swarm in abundance, but in the winter of my need they leave me naked. He is a happy man who hath a true friend at his need; but he is more truly happy who hath no need of a friend."

Considerable applause followed the conclusion of the paper, and Messrs. Sanson, Briggs, Oubridge, Fishwick, and others having spoken approvingly of it, a vote of thanks was awarded unanimously to its reader. Mr. Newton's brief acknowledgment of the vote concluded the proceedings.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

In the absence of any reference to the engraving which illustrates your article on "The Royal Observatory at Greenwich," your readers might naturally imagine that it represented the transit circle described in the text. This is not the case. It is a likeness, and a faithful one, of the altazimuth instrument, which is erected in the new south dome, upon the site of Flamsteed's mural arc.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

December 13, 1865

A PHOTOGRAPHER IN A FIX.

Sir,—Can any of your photographic readers lend me a helping hand in a great perplexity? If so, I shall feel myself greatly indebted to them for their help, and to your valuable paper as the medium through which their assistance is conveyed to me

I am an amateur photographer, and have, I believe, attained some proficiency in that interesting science, both in the landscape and portrait branches, but one thing is a great drawback to me, which I will explain.

I use the "Eagle" albumenised paper, sold by Messrs. Squire and Co., and which, according to the instructions given with it, only require a 40 grain solution of nitrate to sensitise it.

Now I find that when I have floated two or three papers, those afterwards sensitised are, when taken from the bath of a muddy colour here and there, intersected by broad streaks of white or if not exactly in this state, are covered with black fringes resembling clouds. This paper does well for prints in which there is not much white, as in this case the discolouration does not show, and partially goes off in the subsequent processes, but for vignettes or for negatives, in which portions have been blocked out, it is of no use at all. I filter the bath, and I use kaolin, but in vain; the first two or three papers come out clean, and the rest invariably spoiled. R. J. ATCHERLEY.

CONCRETE COTTAGES.

Sir,—As I read of frequent meetings being held for the purpose of considering the best and cheapest method of erecting cottage dwellings, I trust, as you have admitted into your columns an account of a cheap brick costing 15s. per 1,000, you will give publicity to the fact that Mr. Tall, the patentee, is now constructing two houses in concrete at Bexley-heath. This mode of building has been long known. Concrete is of great antiquity, still Mr. Tall can build at one half the cost of brick and mortar.

H. J. L.

SILVERING MIRRORS AND GLASS BALLS.

Sir,—In an article entitled "Silvering Mirrors," in your number of December 8th, three descriptions are given, and amongst them mine is mentioned. Being happy to co-operate with Mr. V. C. Davis to assist persons desirous to silver any kind of glass, I hope, as I give all the necessary information he will excuse my correcting the errors his letter contains.

It is not Drayton's process which is now practised successfully at Paris, it is mine, and on a large scale, under the firm of Brossette and Co., the Co. being myself. My process is now practised successfully in England, Belgium, Russia, Germany, Switzerland, &c. It is as follows:—

Two solutions are first prepared, one is made of nitrate of silver, 100 grains, by instance, treated with 63 grains of strong solution of ammonia, and after with 4.0 grains of distilled water. On the other hand, 100 grains (to name a quantity) of tartaric acid are dissolved in 650 grains of distilled water. This solution must be kept, and exposed to the light some time before using. To prepare, then, the liquid to silver glass, take, for example, ten cubic inches of the above solution of silver to which you add 2.0 cubic inches of distilled water, keeping good agitation, when you pour into it one cubic inch of the solution of tartaric acid.

The glass is well cleaned, first, with a cloth and whiting, after which a plug of cotton dipped in the silvering liquid, and a little putty powder is carefully passed over the surface to be silvered, and when this application is dry, it is removed with a chamois leather, after being well rubbed and washed with another chamois leather, perfectly clean, wetted with distilled water. The glass is then laid down upon a cast-iron table box, heated to about 140° Fahr., and well covered with a layer of about the 1-10th of an inch in depth, which easily stands upon it. In about 25 minutes a uniform opaque coat is deposited. The glass is then tilted, that the liquid may run off, washed with water, dried, varnished, and painted

To silver balls, the primary cleaning of the glass is obtained by pouring into them a very weak solution of fluoric acid, and well shaking it about, then rinsing it several times with distilled water. Taking now the silvering solution, about a fifth part of what the ball would contain is poured into it, and the ball rolled about in hot water for about twenty minutes. The operation is repeated to obtain a more thick coated surface

Naturally, to ensure perfection, a great deal of practice is required, as in many other professions.

I trust now, in comparing Mr. Drayton's method with the simplicity and small cost of mine, Mr. V. C. Davis will, with a little reflection, understand the reason of my process being practised successfully. T. PETITJEAN.

22, Hornsey-street, Holloway-road, London,

December 11th 1865

P.S.—I must add that I had the honour of my process being made the subject of a lecture by Professor Faraday, in 1856.

OUR SUBSCRIBERS' NOTES AND QUERIES.

BLASTING.—Can any one tell me how to use the magneto-electric machine for blasting purposes?—JOHN PROUDLOCK.

MICROSCOPE.—Will any subscriber tell me how to make a cheap microscope? I am much delighted with the directions for a cheap telescope.—RUGTUS.

Will any reader inform me how to find the logarithm of any number less than 10, without the aid of tables, 10 being the base of the system?—W. H. J. P.

TELESCOPE GLASSES.—Will an Economic Artizan inform me where telescope glasses can be procured in Glasgow?—A TIN PLATE WORKER.

GAS.—Can any reader inform me, 1st, the cause and cure of water in gas-pipes laid in the house to supply the fittings? 2nd, to take the black spots out of lacquered gas fittings preparatory to relacquering? 3rd, how to do the Florentine bronze?—JOHANSES

IVORY STAIN.—What preparation will stain ivory billiard balls any colour effectively?—J. SIMPSON.

HYDRAULICS.—A hydraulic water ram is fixed so that there is ten feet perpendicular fall from the head of water to the ram—the length of pipe from head of water to the ram is 30 feet. Required the height to which the water will be raised, and in what proportion is the quantity raised to the quantity wasted, and if the length of pipe through which the water is forced will make any difference in height? If any correspondent will inform me upon it, I should feel obliged.—HYDRAULIC.

LATHE.—Can any reader inform me where I can obtain the iron work for the lathe described in No. 36, Page 116.—HYSSOP.

FRET SAW.—In your impression of the 24th ult. a Mr. Merritt gives a description of a fret saw. Does your correspondent think that his design would be applicable for cutting felloes, &c.? Perhaps he would not think it too much trouble to give a more detailed description of one; or perhaps some other one of your numerous correspondents would give their idea of a saw for cutting felloes, centerings, &c?—WHEELWRIGHT.

GALVANIC BATTERY.—Will any reader inform me of any cheap little work on the construction of a galvanic battery?—J. W. BENNETT

SYPHON ACTION.—I have a syphon fixed to draw water from a cistern, the long leg is 3 feet below the water. The cistern ran empty, and I drew all the water from the syphon. The cistern filled again, and, without removing the air from the syphon, I can draw about half the full stream. After drawing out the air the syphon acts properly, but after blowing the water back into the cistern the water drops a few minutes, and then begins running slowly, as before. Can any of your readers explain this?—E. H.

OVAL CHUCK.—Will Cencino inform me how I can make an oval chuck for a small lathe, to turn and set oval settings for small work?—G. H. D.

SPINNING.—Can any reader oblige me with a description of an ordinary spinning wheel, such as is used in the northern counties of England, or where I can buy one in London?—CALCUM PRIS.

Can any reader inform me how to calculate the horse-power of stationary engines—for instance, say, a cylinder 50 inches diameter, 2 feet 8 inches stroke, what is its power? What is the difference in calculating condensers, and high pressure?—COLEA.

TRANSFERRING.—Will any of your readers inform me of a method of printing from pencil drawings? There is some certain method of making the pencil marks only take ink like a lithographic stone, &c How can I make transfer fluid for the purpose of transferring wood-cuts to paper, glass, &c.?—E. GAR.

COPPER.—It is a curious fact that when copper is made into forgings, the weight of the work produced, together with the scraps cut off, is greater than the original weight of rough copper. Perhaps carbon is absorbed by the metal from the coals of the fire, which causes this strange phenomenon Does it occur in any other metal, and what is the cause of it?—CYCLOPS

SMEE'S BATTERY.—I have just constructed a Smee's battery, and use for my cells some earthenware dishes, 6 inches wide by 8 inches deep, and, although they are glazed over, the acid finds its way through the cells, destroying whatever may be in its way. Will some one kindly inform me how I may prevent the acid from escaping from the vessels, or if wax varnish would adhere to the cells without cracking off?—GULLIVER

A DIAMOND FOR CUTTING GLASS CIRCULAR.—Will any correspondent inform me where I can get one in London?—SILEX.

P.S.—I have your first number of the "Mirror of Science" before me, and I hope you will excuse my candour when I say I consider the MECHANIC of the two is the best value, but I hope the "Mirror" will improve; but I must say the first number is very meagre. I say this in good faith, not as an offensive criticism.—SILEX.

HOLTZAPFFEL'S 4TH VOLUME.—Is this ever to be issued? The amateur mechanical world have been anxiously expecting it for years. Possessing the others, I would give almost its weight in silver for it. A notice in the preface of one of the published volumes says it is even partly in type, and that volume dates several years back.—G. E. C.

TELESCOPES.—Will an Economic Artizan tell me at what optician's I can get, for about 4s., a 35-inch object glass and a 1-inch eye-glass, and whether the image will be chromatic or not?—G. E. C.

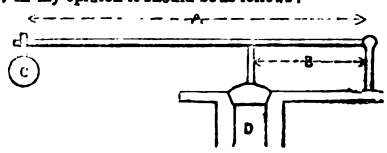
CHUCK.—Will any correspondent tell me how to make a chuck to cut circloids to ornament work in the lathe?—S. D. S.

ELECTRICAL MACHINE.—Having seen described in your magazine (No. 11, Vol I) an electrical machine, I wish the correspondent would let me know where I can procure a cylinder of the size mentioned, viz., 6½ inches by 4 inches? Would it answer to mix amalgam in a crucible, or would the mixture stick to the sides?—QUICKSILVER.

MAGIC LANTERN.—Will any of your readers oblige me by a description of the lines used in a powerful magic lantern, their diameter and focal strength?—W. R.

REPLIES TO QUERIES.

PRESSURE IN BOILERS.—I quite agree with J. S. when he states in your impression of the 1st that G. S. appears to be incorrect, but think he is far from being correct himself; in my opinion it should be as follows:—



Let a = length between weight and standard.
b = do. valve, spindle, and standard.
c = weight in lbs
e = action of weight of lever and valve.
a ÷ b × c + e = weight on d.

Should J. S. or G. S. consider me incorrect, I should be much pleased to hear from them again.—R. P.

EBONITE DISCS.—In reply to Electricity, in No. 37, I believe Silvers', Bishopsgate-street, are the only manufacturers of ebonite discs. Price about (for a 12in.), 7s. or 8s.—the ordinary rubber—O. K.

BRONZING.—In reply to B Kingsland, I beg to inform him I use the following methods for bronzing electrotype medals, which no doubt will be of service to him.

Brown.—Add to a wine glass of water four or five drops of nitric acid, with this wet the medal, allow it to dry, impart a gradual heat, by which the surface will be darkened in proportion to the time exposed

Black.—Wash over the medal with sulphuret of ammonia, which should be dilute, dry with a gentle heat, polish with a hard hair brush.

Green.—Steep a few days in strong solution of common table salt, wash in water, and allow to dry slowly. A beautiful bronze, and very permanent.—E. MCGURK.

SMEE'S BATTERY.—Can any reader tell me what sort of cotton and silk is used for covering copper wire, and where in London I could get it best and cheapest? The following is an excellent substitute for the silver plates in Smee's battery, and has the advantage of cheapness. I have not seen it mentioned anywhere, and think it might be useful to some of your electrical readers:—Get an old saw—a stout pit saw in preference—soften it in a smith's forge, and cut the plates the required size, then insert them in the heart of a clear coke fire, giving it sufficient draught to raise them to a white heat, then take them out and hammer them flat with as little violence as possible, and allow to cool gradually, they are then fit for use; attach a wire or binding screw to one end, and arrange as in Smee's battery. I prepare mine in the furnace of a conical boiler, used for heating a greenhouse, which I find well adapted for the purpose.—A PRACTICAL GARDENER.

SAFETY VALVE.—In answer to Wm. Tonkes, in No. 37 of THE MECHANIC, I think the following will be found correct. Multiply the weight upon the lever by the distance in inches to the fulcrum, and divide the product by the distance between the fulcrum and the valve, and the quotient,

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plus the weight of valve and effective weight of lever, equals pressure on the whole valve, and that divided by the no. of square inches the valve contains, equals pressure per square inch. Thus, suppose a valve and attachments of the following dimensions:—

Length of lever = 14 inches.
Weight of lever = 2·5 lbs.
Weight of valve = 1·5 lbs.
Diameter of valve = 2 inches.
Distance of valve from the fulcrum = 2 inches.
Weight to be suspended on lever = 20 lbs., and to be placed 12 inches from the fulcrum.

Half the length of lever multiplied by its weight and divided by the distance from the fulcrum to the valve equals effective weight of lever.

Thus $\frac{7 \times 2{\cdot}5}{2} = 8{\cdot}75 + 1{\cdot}5 = 10{\cdot}25$, weight of valve and effective weight of lever.

Then $\frac{20 \times 12}{2} = 120 \times 10{\cdot}25 = \frac{1230{\cdot}25}{2 \times {\cdot}7854} = 41{\cdot}459$ lbs. pressure per square inch.—E. FARNSWORTH.

ADDRESS WANTED.—I beg to thank Old Charlie, and Amateur Turner, would feel obliged for the former's address.—SATELLITE.

A, Plaisance Cottages, Jersey.

STEAM PRESSURE.—The pressure got on pistons about 19lb. and cuts off at 2 3rds of the stroke; the diameter of cylinders 28 inches; length of stroke 5ft; revolutions of shaft per minute 49; diameter of oscillating cylinders, 20 inches; pressure expected to work 60 lbs. My best thanks to A Stokes, and others of your correspondents.—D D. D.

GUILLAUME.—1. I don't know of any cheap and easy method of vulcanizing india-rubber. 2. Dental rubber, as supplied from the manufacturers, is perfectly plastic. 3. It is rendered fit for moulding by heating on a hot-water plate, and when moulded, moulds and all are put into a vulcanizer, and exposed to superheated steam for 2 hours, when the models become perfectly hard.—G. E. C.

INLAYING.—About three numbers since, a correspondent inquired for fancy inlaid lines for tables. I can supply him with any kind of inlaying.—A. T. MEASURE.

1, Eaton-place, Wells-street, South Hackney.

CABLE AND MAGNET.—Will Mr. Mulholland let me know the date of his patented "Improvements in Telegraph Cables," made mention of in ENGLISH MECHANIC, No 30, vol. II?

In answer to your subscriber's query in No. 36, vol II., under the name Magnet. I can positively assert, from a long experience, that nothing whatever, placed between a magnet and an object influenced by its attractive power will destroy, wholly or partially, the influence of the magnet on such object, except an opposite pole.—VERITAS.

[The above correspondent is the patentee of a mariner's compass to resist the attraction of the iron on board of iron ships, it is now at sea and promises to be a success.]

ELECTRO-MAGNETISM.—I beg to thank Mr. R. W. Willis for his kind and courteous information in reference to the practical trial of my suggestion in your No. 33, to propel ships by means of electro magnetism, generated by the ships themselves through the means of copper and zinc sheathing.

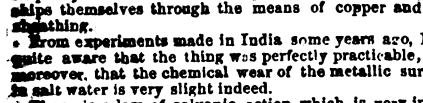
From experiments made in India some years ago, I was quite aware that the thing was perfectly practicable, and, moreover, that the chemical wear of the metallic surfaces in salt water is very slight indeed.

There is a law of galvanic action which is very imperfectly understood at the present day. In small batteries when you increase the metallic area, you increase the electrical power. This can be calculated up to a certain point. But when you come to hundreds of superficial feet (as in the case of a ship's sheathing), the power increases in an immense ratio.

All minor difficulties in respect to insulating the plates of copper and zinc, are easily overcome. I believe that in electro magnetism, we have a motive power at present little thought of, especially at sea, where the chemical excitant is always at hand.

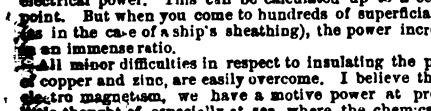
I shall be glad to hear that others carry out the idea I have so long entertained.—JNO. TAWSE.

THE DANIELL'S BATTERY, as described by Alfred Crofts should be very intense, but certainly would not work for long with acid, without destroying the zinc; nor do I think his battery calculated to "last constant" any length of time. Such an one as is used in the telegraphic offices would answer his purpose. A box of baked wood, or wood coated with a solution of shellac or resinous substance, divided into ten or 12 cells by slate divisions, all to be quite acid tight, with copper and zinc plates about 5" wide, and 4" deep, one pair in each cell, connected in the usual way, zinc to copper, thus:—



The discs to be well amalgamated; the acid, 1 sulphuric to 15 water; sand is used in the cells, when the battery has to be moved about much, it being well moistened with [illegible]

[illegible] have constructed some round Daniell's batteries for private use, thus:—



C, is a copper cell with brass binding screw; L, is a leather diaphragm with a round piece of wood fitted in the bottom water-tight; Z, is a zinc tube amalgamated, cast hollow right through, with a binding screw attached, put the zinc into the leather and the whole into the copper cell; fill zinc with sulphuric acid diluted, and the copper outside the leather with sulphate of copper nearly to the height of acid within the leather. I would recommend Mr. Alfred Crofts to Mr. R. W. Sykes, practical electro-mechanist 4 Holly-place, Stockwell, S. E., who will, by private letter, answer any question correctly, as he has done for me before now.—W. HOSKEN.

STEAM WHISTLE.—In answer to Henry Williams, I beg to submit the following, trusting it will give satisfaction:—

FIG. 1. FIG. 2.

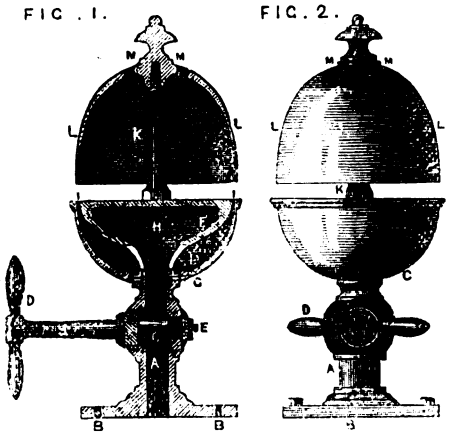


Fig. 1 is a section, and fig. 2, elevation. The same letters do for both. The foot A is cast hollow; the flange B, being for the purpose of bolting it to the boiler; the cock C, with the handle D, is screwed tight by the screw E; the piece F, screws upon the foot A, fixing the cup G, so:—

And both are turned truly at their outer edges, leaving a very narrow passage, I, I, between them all round; the piece F, is hollow and has holes H, in its sides; the pillar K, is fixed upon its centre; the bell, L, L, is screwed upon the pillar, the bottom edge of which is very thin, and is made so as to come exactly over the opening I, I, and at about ½ inch above it. When the cock is opened to admit steam, the steam rushes through the holes H, and out at the narrow opening I, and strikes the thin edge of the bell L, producing a sharp shrill sound. Some holes, M, are sometimes made to allow the steam to pass through, which improves the sound considerably. Fig. 2 represents an elevation of the steam whistle, the cock D, being shut.—E. J. WITCHELL

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

GEORGE ADAMS can scarcely be a very attentive reader, since some three or four directions for purifying oil have recently been published in THE MECHANIC.

A. A. GLASGOW.—Write again, and use common writing ink, your letter stuck together and blurred in the folding so as to be quite unreadable.

BURSLEM.—The greater number in Birmingham.

SUBSCRIBER FROM THE BEGINNING.—Often tried, but never with success.

T. E. M.—Try Edgley, Engineer, Lamb's Conduit street, London.

J. J. H.—Write to Mr. H. Laxton, 34, Arundel street, Strand.

H. PIDCOCK.—Write to Munn and Co., Patent agents, New York City, U. S.

DICK POLLARD.—You require more than can be taught by an answer from any of our turning friends; obtain a lesson or two of a practical man.

J. W. HUMPHREYS.—They are very numerous, and differ much in construction; you can obtain a specification at the office of the Commissioners of Patents, Southampton-buildings, Holborn.

EMERALD.—What do you say to Jackson's, in present number?

MAGNETISM.—We have heard of the invention, and when opportunity offers intend to describe it.

B RUSSELL.—Search back numbers, the question has been answered more than once.

EXETER.—Try again, mix with a small quantity of size, not a patent.

LUBRICATOR.—Received.

JOHN MCMURRAY.—Received, but too late, we shall be glad to hear from you again.

E. GAR.—You can obtain the pamphlet for a penny or twopence.

ROBERT ALEXANDER.—Write again, not received.

THOMAS DUNBAR.—Attended to

J. W. R.—Other drawings will soon appear.

SANDY SLOAN.—Why not try the experiment, it is worth the trouble, and is easily managed.

GEORGE UNDERWOOD.—Write to the office of the Commissioners of Patents, Southampton-buildings, Chancery-lane. You will perceive by the notice in THE MECHANIC, that we cannot forward specifications from the office. The authorities refuse to receive postage stamps over the counter.

J. H. M.—Very good.

E. CRICH.—Thanks for your kindness.

ELECTRIC SPARK.—The springs can be re-tempered. 2. Of the publisher only, so far as we know. 3. Not at present.

EDWARD HENDERSON.—We may find space to insert the letter and engraving in the enlarged Christmas number, if you forward them at once.

VERITAS.—Protection only we think.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

GENERAL NOTES.

EHRENBERG states that the bog-iron ore of which the Berlin iron castings are made had its origin in living creatures—animalculæ, which preserve their vitality even when immersed in the strongest muriatic acid.

IT has recently been found that the unctuous clay, overlying the ironstone deposits of the Yorkshire moors in the North Riding, can be made to produce a mineral oil, similar to petroleum, at a cost of 6d. per gallon.

THE NEW BLASTING POWDER.—A comparative trial, extending over upwards of a month, has been made at the Roundwood Tunnel, near Dublin, for the purpose of ascertaining the practical value of Messrs. Schaffer and Budenberg's new blasting powder. With the new powder, the progress made with a driving in No. 1 heading, 6 ft. × 5 ft., was 7 ft. in 168 hours, whilst with the old powder it required 200 hours to drive 4 ft. 5 in. In No 2 heading, dimensions as before, with the new powder, 5 ft. was driven in 168 hours, whilst with the old powder only 4 ft. were driven in 200 hours. It will thus be seen that 41 per cent. more work was done in 16 per cent. less time.

PETROLEUM AS STEAM-FUEL.—The experimental boiler made in the factory at Woolwich Dockyard, and which has been at work at intervals during the past fifteen months, in testing petroleum, shale, and other oils for steam purposes, to supersede the use of coals, has been given over to the Admiralty authorities by Mr. Richardson on the completion of his experiments, which, it is stated, have thoroughly matured the principle, and rendered his theory a matter beyond doubt. Mr. Richardson has likewise, at their Lordships request, submitted plans for the conversion of the ordinary ships' boilers into boilers for which petroleum can be used. This, it is said, can be done at small cost.

VESSELS composed of iron plates have been employed for more than fifty years in the navigation of canals, but it is not more than twenty-five or twenty-six since they were first introduced as sea-going vessels. It is true that an iron vessel was built in 1820 from designs by the late Mr. Aaron Manby, and navigated from London to Havre, and on to Paris, but this was not a sea-going vessel, but an iron steamer constructed for the Seine.

IMPROVED QUARTZ CRUSHING MACHINERY.—Mr. Andrew Buchanan, of Brooklyn, New York, has invented a machine for quartz-crushing and similar purposes, in which two segments are employed, with smooth or corrugated faces, the said segments being hung on rock shafts or gudgeons, and connected at or near their peripheries to a lever or other suitable device, in such a manner that, by the action of the said lever or other device, a very powerful oscillating motion can be imparted to the segments, and quartz or other materials placed between their faces are crushed with ease and facility. If a lever is used to impart to the segments the desired motion the crushing power can be increased to any desired extent, and the motion of the segment can be easily adapted to the material to be crushed.

FROM the report of the eighth census it appears that there are seven establishments in the United States for copper rolling. These establishments employ 413 hands, and have a capital invested of 2,470,000 dols. The cost of material consumed by them is valued at 2 537,000 dols.; the cost of labour at 157,080 dols.; and the annual value of products for the year ending 1st of June, 3,198,768 dols.

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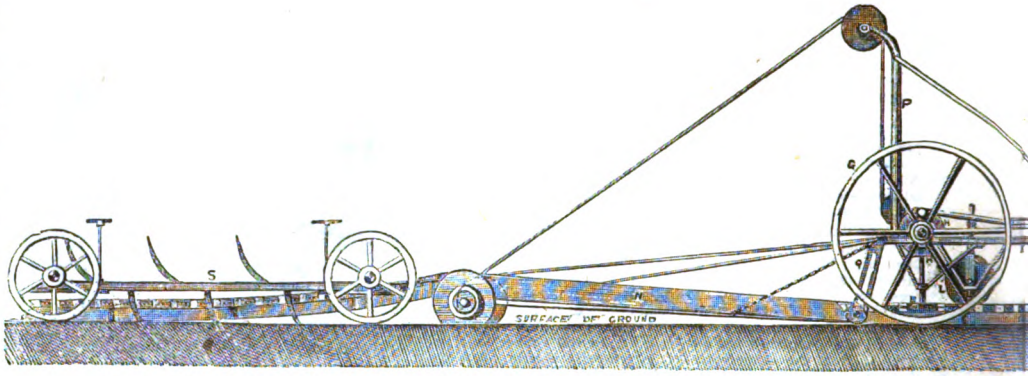
AGRICULTURAL RAILWAYS.*

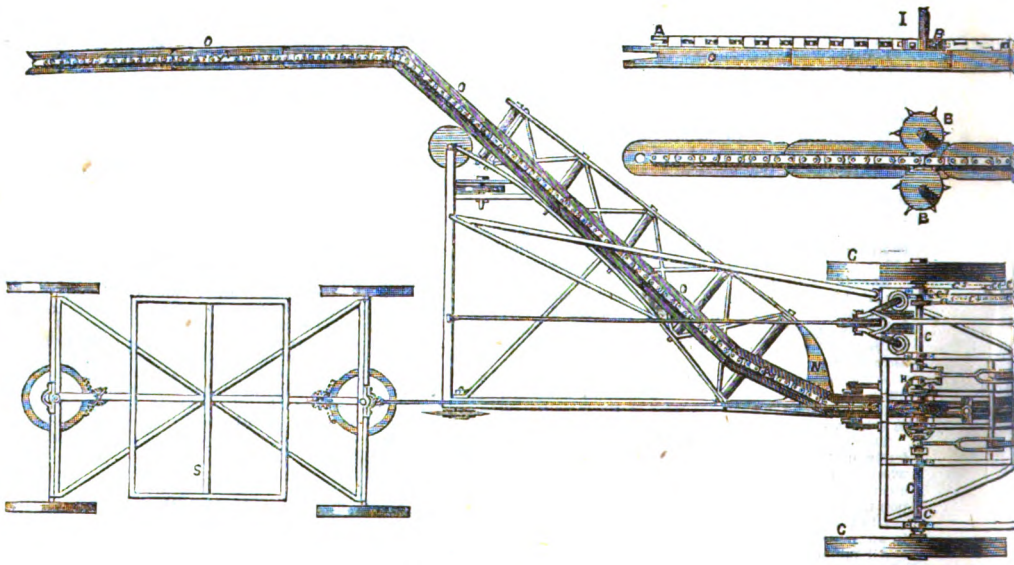
Mr. Richard Winder, engineer, 18, Abingdon-street, Westminster, has lately patented an ingenious application of railways to agricultural purposes, more particularly for ploughing and cultivating the land by steam power. He proposes to use a single line of railway (centrally placed) which supports the chief dead weight of the machine that travels across the land: and is the means also, whereby the machine is propelled forward by the spiked pinions described hereafter. The central rail and jointed sleepers also prevent the machine sinking in from the extent of area of bearing surface of the sleepers; hence the power of the engine is wholly available for the work to be done. By this patent it is also intended to make the rail available for helping traction engines up steep inclines, when travelling along the various hilly country roads, by a simple and cheap alteration, and to reduce the dead weight of the machine to a minimum. The engine and boiler frames are made of T-iron; and the bulk of the coals and water will be upon the headland anchors, sufficient being taken upon the machine from time to time to last for one or two journeys across the field from headland to headland. And in comparing this plan with others in present use, it will be seen a single length of chain is only required; which is half the length of the rope of the best plan in present use; all friction, wear and tear, and loss of power of the present moving ropes is done away with, all snatch blocks, rope porters, windlasses, clip drums, and the apparatus for working the same are dispensed with, the headland anchors also are very much simplified; and the power of the engine is best obtained by being always close to its work. To enable our readers to understand the details of this invention we annex the following explanation having reference to the drawings on this page.

The accompanying engravings clearly illustrate the manner in which this invention is carried into effect. Fig. 1 is a side elevation, and fig. 2 a plan of one of the apparatuses complete; fig. 3 is an elevation of the jointed sleepers and flexible central rail showing one of the spiked pulleys working therein; fig. 4 is a plan showing both spiked wheels set out for working the machine forward along the flexible central rail; fig. 5 is an elevation of one of the jointed lengths of the sleepers; fig. 6 is a plan of the same; fig. 7 is an elevation of one double link and one single link of the flexible central rail; fig. 8 is a plan of the same; fig. 9 shows the complete apparatus at work. A A is the central rail formed of links with lateral spaces between them. The rail is fastened by countersunk bolts to the jointed sleepers O, one bolt in the centre of each length of sleeper. It is likewise fastened at each headland to anchors of any simple kind travelling upon wheel or discs, as shown in the view fig. 9, where X X are the anchors. The central rail carries the chief portion of the dead weight of the machine upon the grooved wheels L L L, fig. 1. B B are two pinions or wheels having projections or spikes upon their peripheries. These spikes fit in between the links of the flexible central rail, and being caused to revolve propel the machine forward. C is the main shaft of the machine. D D are the cylinders of the engine. E is the boiler. F F is the steam pipe leading from the boiler to the cylinders. G G^1 are the high wheels that carry a portion of the dead weight of the apparatus when ploughing, and the whole of the weight when it is used as a traction engine; these wheels run loosely upon their axles. H H H are cog wheels which drive the spiked wheels B B by vertical shafts I I. These shafts are fitted with long feathers or keys so that they can work freely up and down through the horizontal cog wheels H H in order to compensate for any unevenness of the ground passed over. The shafts are also coupled together, the coupling having in the centre a right and left hand screw, so that by turning the screw one way the spiked wheels are forced further apart, and thus thrown out of gear with the rail, and by turning it the reverse way the spiked wheels are brought closer together and placed in gear with the sides of the rail, and by screwing together still closer, additional friction is obtained by pressing the wheels against the sides of the flexible rail, and in place of the coupling above described an elastic or spring coupling is sometimes used. K K is the frame of the apparatus made in two parts the more equally to distribute the dead weight to be carried over the land and to allow of its accommodating itself to the inequalities in the surface of the ground. One part of the frame carries the boiler the other part the engine's main shaft and other working parts, L L are the grooved wheels which run on the top of the central rail A. Springs are provided to allow these wheels to adapt themselves to the unevenness of the ground passed over. M is the grooved pulley on the lower part of the boiler around which the rail may be coiled for transport. This pulley can be made either to take off altogether, or be raised up outside the boiler out of the way when not required for use. It is either worked by a cog wheel attached by a connecting rod to the engine as shown in the engravings, or it can be worked by hand. N is the frame for shifting the central rail and sleepers to the new position ready for the apparatus to travel upon in the return journey. The frames are raised alternately out of the way, and owered into their work according to which way the machine is travelling. At N, figs. 1, 2, the frame is shown in work, and at N^1 it is shown raised up out of its work. When the apparatus is at work the frame N in work is shifting the central rail at the same time the apparatus is travelling across the field drawing the plough or other implement after it. Upon arriving at the headland this frame N is raised up out of the way, and that on the opposite end of the apparatus is lowered ready to shift the central rail to the required new position while the machine is making the return journey; thus the frames N N_1 are raised and lowered alternately, shifting the rail each time to the required distance sideways until the whole field is finished; neither engine nor any other part of the machine turns at the headlands. O O are jointed sleepers to which the central rail is fastened. Play is left at the joints to allow the sleepers to adapt themselves to the unevenness of the ground. P P are standards and gearing for raising the guide frames N and N_1 when not in use. Q Q are guides fitted with a recess to hold up the end of the guide frame free of the central rail when not in use. S is the cultivator or plough frame fitted with steering apparatus at each end and with rocking bars to which are fixed tines or shares. This implement does not turn at the headlands.

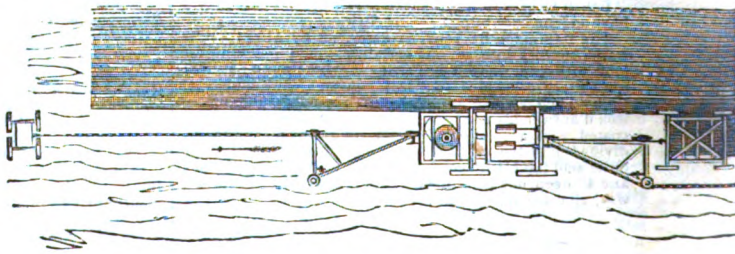
* Extracted from the *Mechanics' Magazine*, November 17th 1865.



ELEVATION OF



PLAN OF THE MACHINE, AND DETAILS OF



GENERAL PLAN SHEW

WINDER'S PATENT SYSTE

IRON AND ITS COMPOUNDS.

Chemists have for some time been aware that there are two metals which were at first confounded under the term *iron;* but which, except that they are capable of being converted into one another, are almost as different as any two other metals with which we are acquainted. It was long supposed that what were termed the proto-salts and per-salts of iron had the very same base, and differed only in the relative quantities they contained of that base; the proportion being 1 to 1 in the proto-salts, and 1 to 1½, or rather—as the existence of a half atom was not to be admitted—of 2 to 3 in the per-salts. The strangely different properties of the two classes of salts, though they always excited attention, did not, until recently, suggest a possibility of their being salts of,

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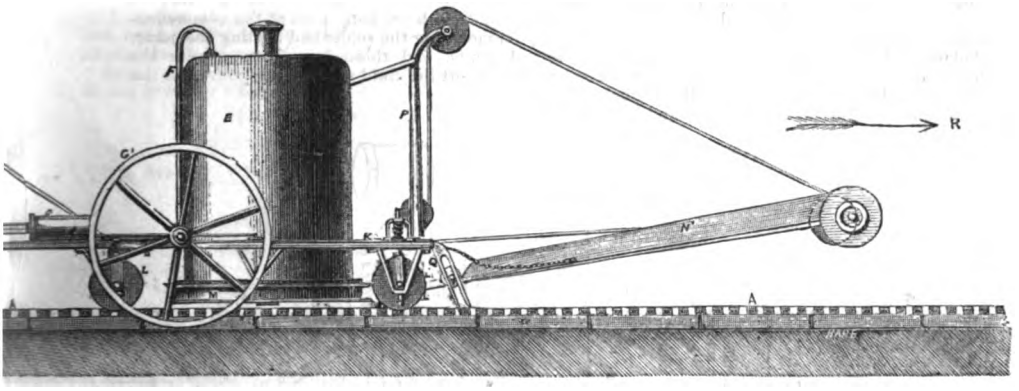
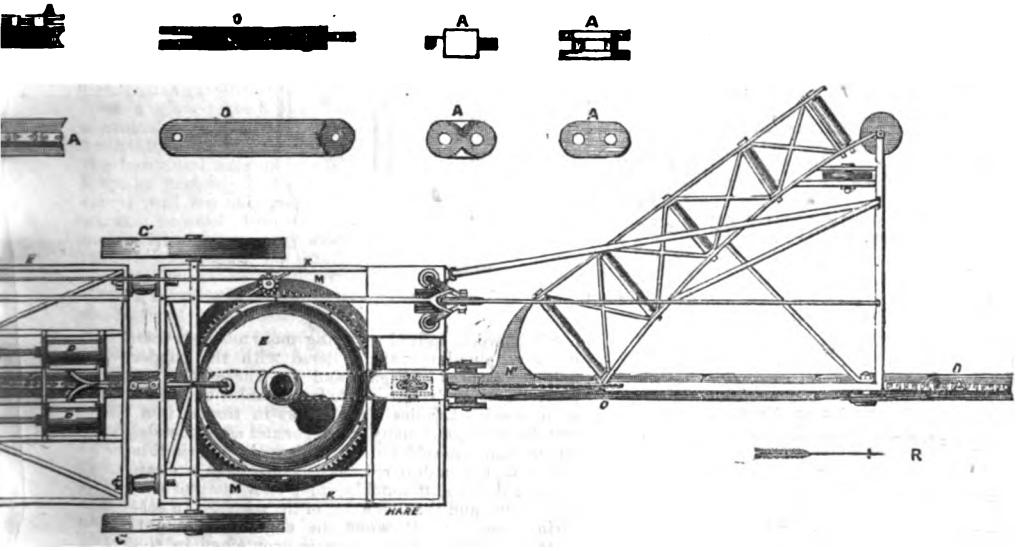
reality, different bases. This view, however, at as forced itself on the minds of chemists, and has been most universally adopted, the names given by Berzelius the two kinds of iron being everywhere accepted.

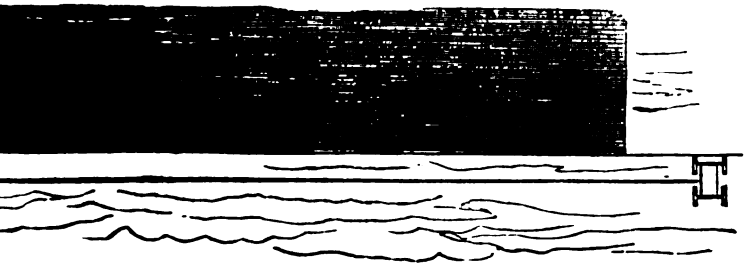
That distinguished chemist termed the base of the proto-alts of iron *ferrosum*, and that of the per-salts *ferricum*—nd, though only allotropic states of the same element, ey are as different in their properties as are the two ses of phosphorus, or those of sulphur. The atomic eight of *ferrosum* is 28, that of *ferricum* is 56. The tomic heat of the latter is twice that of the former.



THE MACHINE.



THE FLEXIBLE RAIL AND JOISTED SLEEPER.



G THE MACHINE AT WORK.

OF STEAM CULTIVATION.

Ferrosum' combines with one atom of oxygen and other elements, ferricum is saturated by not less than three.

The existence of the two bases was considered certain, although only one of them, ferrosum, had been obtained; but even this link in the chain of evidence by which their existence may be established, has now been supplied by M. de Cizancourt. In his researches on the subject, lately brought before the Academy of Sciences at Paris, he has afforded information regarding it which, when fully developed, will most probably be attended with the most important consequences: and may possibly lead to valuable results, in suggesting modifications in the iron manufacture.

Hitherto, the properties of compounds of iron had been considered due merely to the amount of oxidation, or the quantity of carbon, &c., in combination with it. Cast-iron, steel, and wrought iron were believed to differ only in this way; although the fact that difference of property was not always in accordance with difference of chemical constitution constantly obtruded itself: and it ought to have been concluded that chemical composition performs only a secondary part—the first and most important part being connected with some other circumstance which had not been sufficiently attended to. Specimens of cast iron, of exactly the same composition, are often extremely different in appearance and qualities; specimens of cast iron and steel are sometimes not to be distinguished by the relative amounts of the constituents; and specimens of steel and malleable iron are occasionally identical in composition.

M. de Cizancourt has ascertained that the difference is, in reality, to be looked for in the sources whence the iron has been obtained—that is, in the degree of oxidation in which it is found in the ore. Each ore furnishes its own peculiar iron; and, by consequence, only certain ores will afford steel or cast iron of certain qualities.

Ferrosum is the metal of the protoxide; it is found, merely combined with a little carbon, in the white crystalline cast iron, which is so easily obtained from ores of the protoxide, and especially the carbonates; and its characteristic property is its reduction at comparatively low temperatures. It is remarkable for its hardness and its brittleness when combined with carbon.

Ferricum is the metal of the anhydrous per-oxide. It is found pure in the iron obtained from ores containing that oxide: and its characteristic property is its abandonment, during slow cooling, of the carbon with which it combined at a high temperature. It affords malleable iron. By itself it cannot afford stable steel, nor stable white cast iron—at least, by means of metallurgic processes of the ordinary limited duration. Its physical characteristic consists in its malleability, and it loses this only when it attains its ultimate form of blistered iron.

Ferrosum passes easily into the state of ferricum, and in that state retains its quality of hardness: hence it will furnish steel and malleable iron. It has the decisive property of being brought, by means of ordinary metallurgic processes, from iron to steel, and from steel to cast iron. On the other hand, ferricum cannot be changed into ferrosum, unless, perhaps, by very difficult operations: and—when it has been obtained from the compounds of the per-oxide—not so as to be a stable form. If it has been originally ferrosum, it may be made so again.

Malleable iron consists of a mixture of ferrosum and ferricum in various proportions, the ferrosum having been changed, at a high temperature, into ferricum. Its quality depends on the relative amount of each constituent.

Steel, when stable and of a good kind, consists of ferrosum and ferricum in the proportions represented by their atomic weights: hence the magnetic oxide of iron, which contains the two oxides in these proportions, furnishes the best kind of steel. It is worthy of remark, that the magnetic oxide and magnetic pyrites—which both contain the two kinds of iron in the proportion of their atomic weights—are, like hardened steel, permanently magnetic.

Black and grey cast iron differ from the white, in consisting of ferricum, which retains a part of its peculiar qualities, and which, during slow cooling, abandons the carbon it took up at a high temperature. In grey cast iron, the ferricum usually predominates. In the mottled kind, the two irons retain their peculiarities: the ferrosum, combined with carbon, forms the white portion, and the ferricum, with its deposit of carbon, the dark.

The two kinds of iron remain distinct, and preserve their characteristic properties, however mixed together, during most of the processes to which they are subjected in metallurgy.

The relative amounts of ferrosum and ferricum in a given product depend not only on the ore whence it has been obtained, but the temperature and re-agents employed in its manufacture. A low temperature favours the presence of ferrosum; re-agents, such as phosphorus, which combine with odd numbers of atoms of oxygen, not less than three, favour the production of ferricum. The high temperature capable of developing the latter will be required for a shorter time, if re-agents are used in aid of it. When the proportions of ferrosum and ferricum are due not to the ore, but the temperature, or re-agents, they are in an unstable state: which explains the slow effect of time, and the rapid effect of vibration, in deteriorating axles, &c., so as to render them liable to breakage.

When steel is suddenly cooled the carbon is combined in a stable form with the ferrosum, but in an unstable with the ferricum. Subsequent tempering separates the carbon from the ferricum, and restores the malleability of the latter.

There is reason to suppose that the calorific capacity of iron depends wholly on the relative amounts of the ferrosum and ferricum. Should this be found to be strictly the case, calorific capacity may yet be used as a simple and effective means of distinguishing the nature and origin of a given specimen of iron.

TIN.—The presence of lead in the tin employed for coating the sheet iron used for cooking utensils may be at once easily detected by filing off about ten grains of the suspected tin coating, boiling it with an excess of nitric acid diluted with three times its weight of water, filtering, and then adding to the clean liquid a crystal of iodide of potassium. Should lead to the amount of only the one ten-thousandth part be present, a yellow precipitate, not re-dissolved by excess of ammonia, will be thrown down.

POTASSIUM is naturally an expensive metal, on account of the troublesome process required for its reduction. It is likely, however, henceforward to be obtained much more easily and economically, as it has been found by Beketoff that it may be separated from its compounds by means of aluminium—hydrate of potass being the most convenient for that purpose. Its cost will therefore henceforth depend on that of aluminium.

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SOLDERING.

(*Continued from page* 140.)

The works requiring to be hard soldered do not differ greatly in their treatment, therefore but few examples are necessary here—though it should be mentioned some nerve and experience are required, as the melting heat of both metal and solder very nearly approach similarity. The hard solders most commonly used are the spelter and silver solders. The general flux is borax, and the modes of heating are —the naked fire, the furnace or muffle, and the blowpipe, as shown in our last. Fine gold, beat out and cut into shreds, is used for soldering vessels for chemists made of platinum; copper in shreds is sometimes used for iron; gold solders, laminated, are used for gold alloys; spelter solders, granulated whilst hot, are used for iron, copper, brass, gun metal, German silver, &c.; silver solders, laminated, are used for all silver works and for common gold work, also for German silver, gilding metal, iron, steel, brass, gun metal, &c., when extra neatness is required; white or button solders, granulated, are employed for the alloys called button metals.

Several solders contain zinc, which is useful because it increases their fusibility, and where the solder cannot be seen it indicates the completion of the process—for when the solder is melted, the zinc volatises and burns with the well-known blue-coloured flame; and as just at that instant some zinc is consumed, the alloy remaining becomes tougher, and thus more nearly approaches the condition of the metal it is desired to join. Cleanliness of parts before applying the solder is desirous, though where the red heat is employed this does not matter.

Works in copper, &c., prepared for brazing, either by lap or "nick," the grain spelter and borax powder are mixed in a little water, and the mixture is spread as evenly as possible along the joint to be made. Suppose the work to be made is a pipe, then, before placing on the mixture the end is laid hold of by the plyers, and when all is ready, fire included, the pipe is gently deposited on the coke, the foot inserted in the chain attached to the rocking shaft, and the blast let into the fire. Gradually the water evaporates, then the borax "froths," next it flows quietly, like glass; the fire being now bright, and the pipe red, the solder fuses, and runs into the joint, assisted by a tap or two with a tool—the joint is made in a second, and the pipe pitched into the water, or dipped therein to cool. We have seen a joint made so well, and, withal, so easily as not to require the file.

Tubes, however, are generally secured by hoops of binding wire twisted up; and those soldered upon the open fire are most commonly soldered from within, as, otherwise, the heat would have to be transmitted across the tube with greater risk of melting the work before the solder fused. Locomotive boiler tubes are rested on the flat plate of the brazier's hearth, and portions equal to the extent of the fire are soldered successively. The common Birmingham tubes for bedsteads, gasworks, &c, are soldered from the outside; but, as this is performed in shoot furnaces open at both ends, and level with the floor, the heat is applied more uniformly round the work.

Iron requires less precaution, and there is no risk of fusion. Thus, in soldering spiral wires to form the internal screw in the boxes of ordinary tail-vices, the work is coated with loam, and strips of sheet-brass are used as solder; the fire is kept well up till the blue flame appears at the end of the tube, when fusion is complete; the work is withdrawn from the fire, and rolled backwards and forwards to distribute the solder equally to every part. Locks, &c., are also covered with loam, to prevent the iron scaling off. Sheet-iron, we are informed, may be soldered by filings of *soft cast*-iron, applied as in soldering with borax, which has been gradually dried in a crucible and powdered, and a solution of sal-ammoniac.

The finest works in iron and steel, and those in brass requiring great neatness, are treated to silver solder, of which very little indeed is required in the hands of a decent workman. The practice is the same as in brazing: the joint is first moistened with borax and water; the solder is then placed on the oint. In heating, care is taken not to displace the solder; for which reason some boil the borax, or drive off its water of crystallisation at red heat, then powder it, and apply it dry along with the solder. Others, again, fuse the borax on the joint before placing on the solder. Many works united with the hard solders—mathematical instruments, jewellery, &c.—are soldered with the blow-pipe; in nearly all cases supported, and sometimes covered with charcoal, for concentrating the heat.

In soldering gold and silver the borax is rubbed on a slate with water, to the consistence of cream, and is laid on the work with a camel-hair pencil and the solder, either in wire, dust, or otherwise applied. In many works such a delicacy has been attained in the application of the solder, that no scraping or filing of edges is necessary, and the borax is removed by immersion in "pickle."

In treating of soft soldering, it may be noticed that the plumbers' sealed solder (two parts lead and one tin) melts at 440° Fahr.; fine tin solder (two parts tin and one lead) melts at 340°; and the bismuth solders at from 250° to 270°; the modes of applying the heat differ much in consequence.

The following table of alloys and their melting heats, fluxes, and modes of applying heat is founded on one drawn up by Mr. De Claubry, all of which will be occasionally referred to by *figure* and *letter* throughout this matter:—

ALLOYS AND THEIR MELTING HEATS.

No. 1.	1 Tin,	25 lead,	558° Fahr.
2.	1 "	10 "	541 "
3.	1 "	5 "	511 "
4.	1 "	3 "	482 "
5.	1 "	2 "	441 "
6.	2 "	1 "	370 "
7.	1½ "	1 "	334 "
8.	2 "	1 "	340 "
9.	3 "	1 "	316 "
10.	4 "	1 "	365 "
11.	5 "	1 "	378 "
12.	6 "	1 "	381 "
13.	4 Lead,	4 Tin,	320 "
14.	3 "	3 "	310 "
15.	2 "	1 "	292 "
16.	1 "	1 "	254 "
17.	2 "	1 "	236 "
18.	3 "	5 "	202 "

By adding three parts of mercury to number 18 it melts at 122° Fahr., and may be used for stopping teeth.

FLUXES.

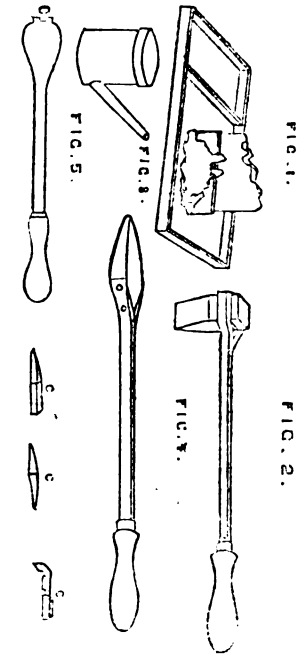
A.—Borax.
B.—Sal-ammoniac, or mur. of ammonia.
C.—Muriate, or chloride of zinc.
D.—Common resin.
E.—Venice turpentine.
F.—Tallow.
G.—Gallipoli oil.

MODES OF APPLYING HEAT.

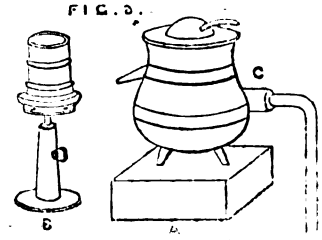
a—Naked fire.
b.—Hollow furnace or muffle.
c.—Immersion in melted solder.
d.—Melted solder or metal poured on.
e—Heated iron not tinned.
f.—Heated copper tool, tinned.
g.—Blowpipe flame.
h.—Flame alone, generally alcohol.
i.—Stream of heated air.

The application of this table is now shown:—Iron, cast-iron, and steel, 8, B, D, if thick heated, by *a*, *b*, or *c*, and sometimes by *g*. Tinned iron, 8, C, D, *f*. Silver and gold soldered with *pure* tin or with 8, E, *a*, *g*, or *h*. Copper and brass, gilding metal, gun metal, &c., 8, B, C, D; when thick, heated by *a*, *b*, *c*, *e*, or *g*, and when thin by *f* or *g*. Speculum metal, 8, B, C, D; the heat to be cautiously applied —sand-bath for preference. Zinc, 8, C, *f*. Lead and lead pipes, or ordinary plumbers' work 4—8, F, *d* or *e*. Lead and tin pipes, 8, D, and G, mixed, *g*, also *f*. Britannia metal, 8, C, D, *g*. Pewters, the solders vary in fusibility according to that of the metal; generally G, and *i*, are used, sometimes also G and *g*, or *f*. The whole of the table of Mr. De Claubry, which enumerates 102 different alloys, &c, may be found, we believe, in "Le Dictionnaire de l'Industrie Manufacturiere Commerciale, et Agricole, par A. Baudimont" (Paris ed. 1833), Vol. I., 326. We may further add here, that iron and brass, &c., are sometimes burned or united together by partial fusion, by pouring very hot metal over or around them (*d*). Lead is united without solder by pouring on red-hot lead, and employing a red-hot iron (*d*, *e*), and also by the autogenous process to be hereafter described.

Soft-soldered joints should be well cleaned, and it is usual with all the metals, except clean tinned plate, or tin alloys to scrape the edges where the solder is wanted to adhere. Lead works are first smeared round the intended joint with a mixture of lampblack and size, to prevent the adhesion of the intended solder; then the parts to receive the solder are scraped quite clean and the clean part rubbed over with tallow. Some joints are wiped without using the soldering iron; A, *i*, *e*, the solder, is heated just below melting point, poured on the joint to heat it; the solder is then smoothed with the well greased piece of bed-tick, with which the surplusage of solder is removed. Other lead joints are left in ridges from the bulbous end of the iron, which is heated nearly to redness, and not tinned; the iron and cloth are both used at the commencement, for moulding the solder and heating the joint. Vertical joints, and those for pipes, require the cloth to support the fluid solder when poured on the lead.



Slight works in lead requiring more neatness than ordinary plumbing are soldered with the copper bolt represented in Figs. 2 and 4. These bolts are pieces of copper rivetted into iron shanks, and fitted with wooden handles. All works in tinned iron, and sheet zinc, and many in copper and other metals, where thin, are soldered with this tool. To tin this bolt heat it to a dull red, hastily file it to a clean surface, then rub it quickly, first on a lump of sal-ammoniac, and then on a bit of tin solder. In soldering coarse work, when the edges are brought together, slightly strew on resin, contained in the box, Fig. 3—the copper bit is held in the right hand, the cake or strip of solder in the left, and a few drops are melted along the joint at short intervals. The bolt is then used to heat the edges of the metal, and to fuse and run the solder. The tool must not be too hot, else it will not pick up drops of the solder from the cake on the tray, Fig. 1, to distribute it along the edge. The tool is sometimes passed only once slowly along the work, but the operator is in this case dexterous, uses a tool with a thin keen edge, and the flux used is muriate of zinc, with which the joint is moistened with a bit of wood, previous to the application of the tool. One section of the tray is devoted to a wet rag, on which to cool an overheated tool.



Copper works are commonly fluxed with powdered sal-ammoniac, and so is sheet-iron; but various methods are adopted by various people but any mode will suffice so long as the metals are de-

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fended from oxidation. Zinc is more difficult to solder than other metals. The flux sometimes used is sal-ammoniac, but the muriate of zinc (made by dissolving fragments of zinc in muriatic acid, diluted with an equal quantity of water) is superior, and serves well for all the other metals, without strict necessity for clean surfaces.

We are here reminded by a correspondent that in soldering small articles a difficulty is experienced in using the common copper bit or blow-pipe, from the heat given forth passing to the parts of the work surrounding that to be soldered. The tool at Fig. 5, with the bolts *c*, *c*, *c*, inserted at *c* in the holder will obviate this difficulty. In using it, heat the iron red-hot, slip in the bolt—in a minute it is hot enough to do its work.

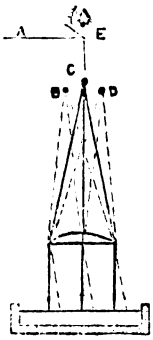
Space compels us to leave the description of Fig. 6, the pewterer's hot air blast, until our next.

(To be continued.)

THE ROYAL OBSERVATORY AT GREENWICH.*

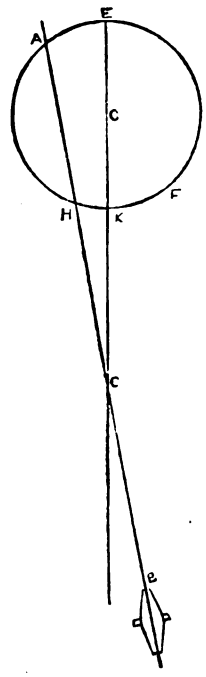
(Continued from page 138.)

The interior of the tube, its glasses and wires, being now all right, or the amount of error known, the outside requires attention, for should the pivots on which it turns be out of level, the telescope will be tilted on one side, and not point to the meridian, consequently, the unfortunate astronomer will see the star cross the micrometer wire before or after it is on the meridian, and he will register the real time of transit incorrectly. Thus it is necessary to test even the polished iron axis and its bearings, and this "error of level" is ascertained, not by a spirit level, but by the following very ingenious and simpler contrivance. The transit circle telescope is turned completely upside down, till it points to a trough of mercury beneath. A ray of light from a gas jet is then thrown from a glass plate E on all the micrometer wires, which are thus brilliantly illuminated. Should the horizontal axis of the telescope be perfectly level, the observer will see only one set of wires, because the reflected images from the mercury will be thrown back upon, and exactly coincide with the real wires. Should the pivot be out of level, the real and reflected wires will not coincide, consequently the observer at E will see two sets of wires, one set rather more brilliant than the other. In the cut the central micrometer wire C illustrates the principle. Should the pivot not be out of level, one wire only will be seen at C. Should it be out of level, for instance, at B, the dotted lines show how the image will be reflected by the mercury to D, whereby the astronomer will see two wires B, D, instead of one. By moving the micrometer wire the two sets of wires are made to coincide, the mean of the micrometer readings is taken, and the difference between the mean reading and the reading corresponding to the line of collimation, is the error of level.



But the cares of the astronomer are not yet over. If the Connecticut witches, who, as everybody knows, once swept the cobwebs out of the sky, had only left one thread in the true meridian of Greenwich they would have saved a deal of trouble. The true central line of the telescope has now been ascertained, as well as the level of the pivots, consequently, the tube will do to take an observation of a star crossing the zenith. Should, however, one of the pivots be too far north or south, on turning the telescope over towards the horizon, every inch of that motion will make it point more and more away from the meridian. This is known as the "azimuthal error," and is not very difficult to ascertain. Should the tube first point to the zenith, and the axis rest truly east and west, on the turning the telescope over it must at last come plump upon the North Star, the whole of its motion being in the true meridian. As a matter of fact the mechanical portions of the apparatus are so well made, that on swinging the telescope over the North Star does always come into view, but the North Star has an apparent orbit the centre of which is the true north, and not the star itself.

The azimuthal error, then, is determined by observations of Polaris, or of λ Ursæ Minoris, at consecutive passages above and below the North Pole. Other stars also can be employed, sometimes, for instance, the stars Cephei 51 (Hev.) and λ Ursæ Minoris. However, the North Star may be chosen to illustrate the method of detecting the amount of azimuthal error. Let A, E, F, H, be the small circle described by the Polaris the North Star, round G, the true pole of the heavens, the line E, G, D, being the true meridian of Greenwich, and C the zenith. Should the eastern pivot of the transit circle telescope be too far north, a line A, B, through its centre, instead of coinciding with the true meridian, will cut the circle at A and H. As Polaris takes twenty-four hours to complete the circle, if the telescope pointed to the true north, the star would cross its field at K, and exactly twelve hours afterwards at E. If, however, as in the cut, it did not point to the north, the star would cross it at H, apparently behind time, and again at A, apparently before time, the whole interval being considerably less than twelve hours. This period of time gives the data from which the azimuthal error is computed. The azimuthal error tables commonly used at Greenwich are for the most part based upon observations of Polaris above and below the pole. The angle of error is computed from the zenith, at C.



The cast iron graduated vertical circle of the transit instrument, for "zenith distance" observations, is 6ft. in diameter, with two sets of divisions. The set on the western side is cut upon a band of silver let into the iron, and divided into five minute spaces, which have to be read by microscopes; the other side is divided by points to every five seconds. There are six reading microscopes, which are simple perforations through the stone pier, having their object glasses inside, next to the graduated circle, and their eye-pieces outside, in a circle about 21in. in diameter.

Such are the leading features of the great transit circle at Greenwich Observatory. After all the care that is necessarily taken to learn the amount of the sources of error, it does not follow that when an observation is made that the telescope itself points to the true meridianal line. Its deviations from that line are however known by the above tests, and the error allowed for by calculation rather than by adjustment of the instrument. The error of collimation is much under control, and kept very small by adjustment, the remainder being allowed for in the calculations.

The altazimuth instrument, as represented above, was erected in 1847, specially for lunar observations, Mr. Simms being the optician, and Messrs. Ransomes and May the engineers. Like the great transit circle, it has a very firm foundation, consisting of a three-rayed pier of brickwork, built up from the solid ground, and having no connection with the building. The radial arms of the iron triangle, supporting the upper part of the instrument, rest upon a smaller pier on the centre of the brick pillar. All parts of the frame possess great firmness, the principle of construction adopted, being to make as much of the instrument as possible in single solid casts of metal, to avoid the use of small screws, and to give the observer no power of adjustment. All errors are calculated by the methods already described, and allowed for when reducing the observations. The altazimuth instrument, like the great transit circle, has a room to itself, with the usual mechanical appliances, for opening and closing the shutters in the sides and roof.

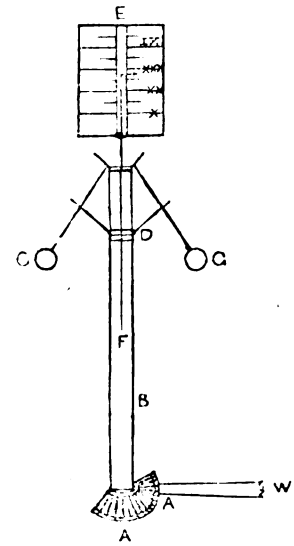
The Astronomer Royal thus describes the instrument:—"For the support of the upper pivot a horizontal iron triangle is carried by the three-rayed pier; on each side of this there is mounted a vertical iron triangle; and the three vertices of these are connected by an upper horizontal iron triangle; three radial iron bars, supported on its angles, carry, at their point of union, the Y in which the upper pivot of the vertical axis turns. The frame revolving in azimuth consists of a top and bottom, connected by two vertical cheeks, all of cast iron; the microscopes for viewing the divisions of the horizontal circle are cast in the same flow of metal with the bottom piece, and those for viewing the divisions of the vertical circle are cast in the same flow with one of the vertical cheeks. The vertical circle and telescope are of gun-metal; the side of the circle which carries the graduated limb, the ends of the telescope, and one of the pivots, being cast in one flow; and the other side of the circle and its pivot cast in another flow. The diameters of both circles (horizontal and vertical) are 3ft.; the length of the telescope is 5ft.; the aperture of its object glass 3¾in. The top carries two levels and the bottom carries two levels, parallel to the axis of the vertical circle; the vertical cheek which carries the microscopes carries also two levels parallel to the plane of the vertical circle."

(To be continued.)

(* Extracted from the *Engineer*.)

VELOCIMETER.

A simple piece of mechanism, which shall at once tell the distance to which the vehicle it is attached has run, and the consequent speed per hour, is a something which has yet to be manufactured. It has often been attempted—we are not aware that it has been achieved, so as to be readily applicable to cab or hansom, or locomotive engine. Such an index in a railway carriage would be a great convenience to passengers, and its presence there would operate as a mental check on a driver tempted, through slacking pace here and there, to make up for loss time by racing his train. The annexed sketch, which has been forwarded to us by a correspondent named "R. J. Atcherley," is an offer in this direction; but, whilst saying that it will not do, for reasons which are self-evident, yet we give it publicity for the purpose of drawing forth the inventive talent of some one or more of our readers.



A, A, are levelled wheels, applied to change the direction of rotary motion; B is a hollow rod containing a smaller rod F, which is fastened in a loose socker to the sliding clasp D, and which, when the wheel at G is in motion, and the iron balls G, G, rise with the increasing speed, will mark on a graduated index at E, the rate of the speed per hour in miles at which the said wheel is moving.

ALLOY.—"Fusible metal" consists of two parts by weight of bismuth, one of lead, and one of tin. It received its name from being at the time of its discovery, and long after, the most fusible metallic compound known. It melts at about 200 deg. Fahr. It has been found, however, that the addition of cadmium renders the point of fusion still lower. Thus, one equivalent of cadmium and one of bismuth, one of lead and one of tin, or two of bismuth, two of lead, and two of tin fuses at about 155 deg. Fahr. Three equivalents of cadmium, four of bismuth, four of lead, and four of tin fuses at about 153 deg. Fahr. And four equivalents of cadmium, five of bismuth, five of lead, and five of tin fuses at 150 deg. Fahr

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KRUPP'S STEEL TIRES

Mr. Thomas Prosser, Krupp's agent in America, has issued a pamphlet from which we extract the following:—"Mr. Winslow (master mechanic of the Housatonic Railway) states that the Reindeer, weighing 45,054 lb., ran 72,483 miles, with an average wear by abrasion of 3-16in., on a set of four of Krupp's cast steel tires. These wheel tires, which were 57·75in. diameter when they commenced running, where 57·375in. diameter when they had run these 72,483 miles; the average width of the wear of each tire was 2¼, which gives 87 lb.=1·49 lb. per thousand miles for a 25-ton engine, as the amount of wear by abrasion only. The wear by abrasion of the puddled steel tires on the Luxemburg, we have seen, was 4·117 times as much as Krupp's cast steel ones, and we are quite certain that iron ones wear much more. Hence we assign 358lb. for loss of metal by mere abrasion of puddled steel tires in running 60,000 miles =6·14 lb. per 1,000 miles with a 25 ton four-wheel locomotive, while a former statement makes the loss of iron tires 7·217 lb for the same service.

IMPROVEMENTS IN STEAM ENGINES.

Mr. Geo. Yellott, of Baltimore, has invented an engine, in which the cylinder is constructed in two sections, of unequal diameter, each section being one-half of the whole length of the cylinder, with the end of the section of larger diameter open, and the end section of smaller diameter closed, with a piston fitted air-tight and steam-tight in each section, and the two pistons connected by a piston rod, so that when steam is admitted into the smaller section and acts against the piston in that section, the other piston in the larger section may be driven out against the resistance of the atmosphere, and the reactive pressure of the steam on the closed end of the smaller section of the said cylinder occasioned by said resistance may be used as the motive-power of the engine. He also claims as part of his invention the cylinder in combination with and placed horizontally on the platform supported at its outward edge by the wheel resting on the circular rail, and attached to and revolving with the vertical shaft, with the upper and lower extremities of said shaft working steam-tight in the two steam-tight boxes, and with the hollow spaces in the upper and lower portions of said shaft, for the admission of steam from the boiler and the escape of exhaust steam, the said cylinder being placed on said platform, with the closed end of the smaller section perpendicular to the centre of motion of said vertical shaft, and firmly attached to said platform, so that it may be made to revolve with it. He likewise claims other modifications in detail of the same arrangement.

MODELS IN THE SOUTH EASTERN INDUSTRIAL EXHIBITION.

Amongst the most remarkable objects in mechanics are Messrs. Penn and Co.'s superb model of the engines of the Minotaur and the Northumberland, of 1,350-horse power, the model being made to the scale of one inch to the foot. For compactness of arrangement, completeness, and effective working, we venture to think that these engines are as yet unsurpassed by any others hitherto constructed. Immediately adjoining Messrs. Penn's model is another, almost equally beautiful, contributed by Mr. John Matthews (of the same firm), showing the parts, in all their details, of a direct-acting marine engine, fitted with an ordinary paddle-wheel on the one side, and with feathering blades on the other. Adjacent to these is a model somewhat rougher in finish, yet tolerably sightly, of a cigar boat for sailing. The cigar boat that is being built on the other side of the river, and which has excited considerable interest in the district, has attracted the attention apparently of Mr. W. H. Child, a journeyman shipwright, who has made a model considerably different from the vessel being constructed at Blackwall, in this especially, that Mr. Child puts a deep—very deep—keel to his vessel. It is professedly adapted for sailing, and not steaming, and as yet on the Serpentine, and in any other contests in which it has had the chance of engaging, this model has beaten hollow all the miniature clippers that have been tried against it. The body of the boat is of zinc, the keel of lead. It is about 3½ft long.

In the time of Henry VIII. the Royal Navy consisted of one ship of 1,500 tons, two of 800 tons, three of 600 tons, and six or seven smaller. At his death the navy was extended to fifty ships, making 12,000 tons, manned by 8,000 men. Elizabeth's fleet in 1588 consisted of one hundred and seventy-six ships, with 15,000 men At the death of George II. there were four hundred and twelve ships, measuring together 321,000 tons.

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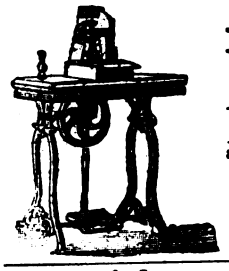

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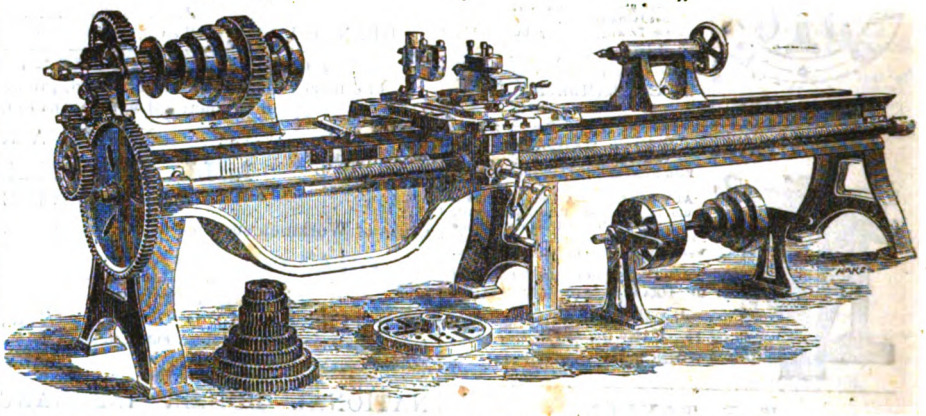

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A Record of Mechanical Invention, Scientific and Industrial Progress, Building, Engineering, Manufactures, Arts, &c.

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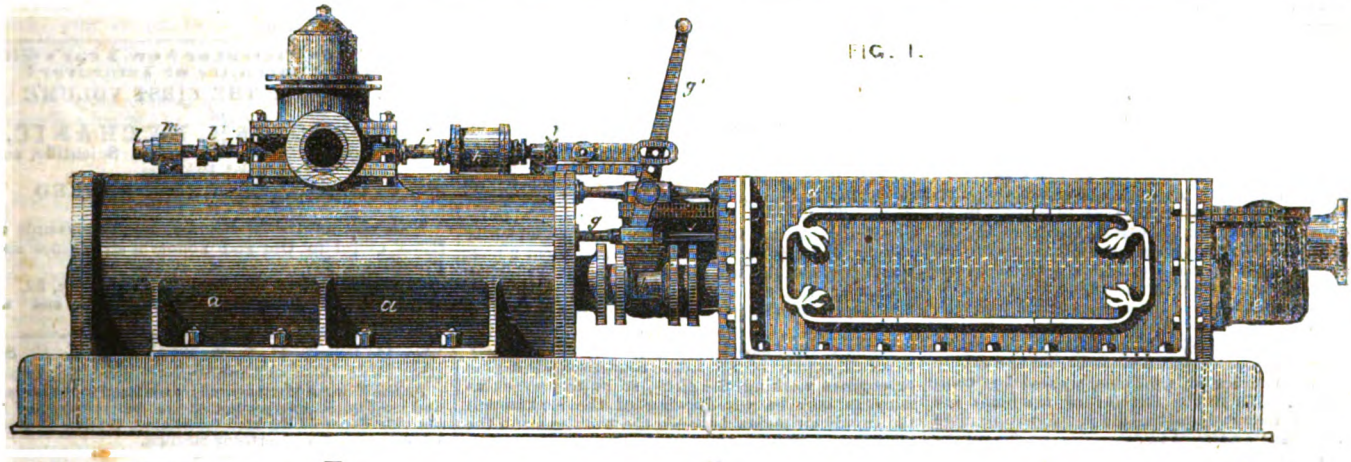

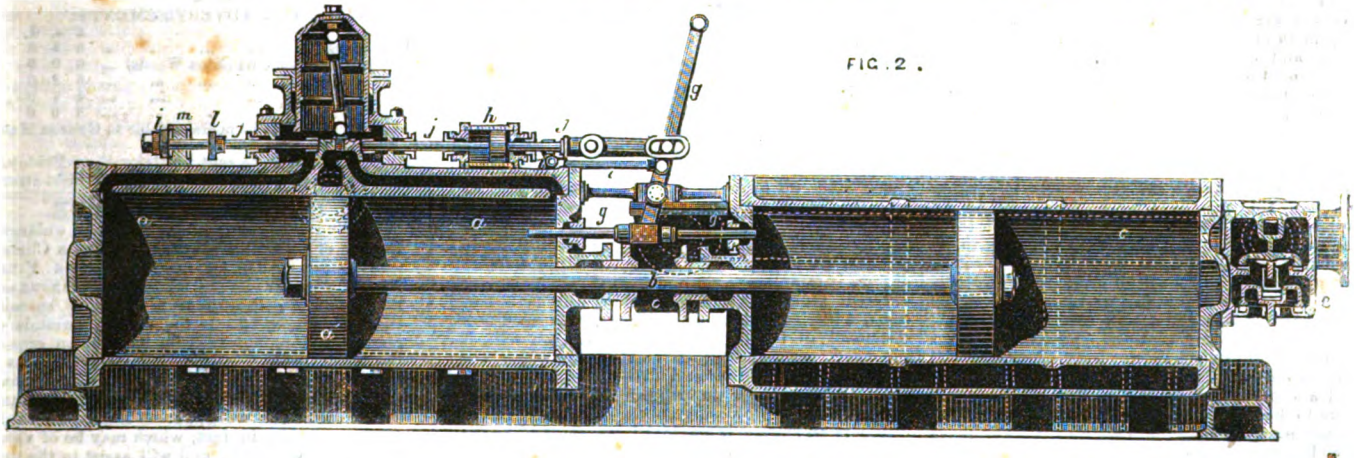

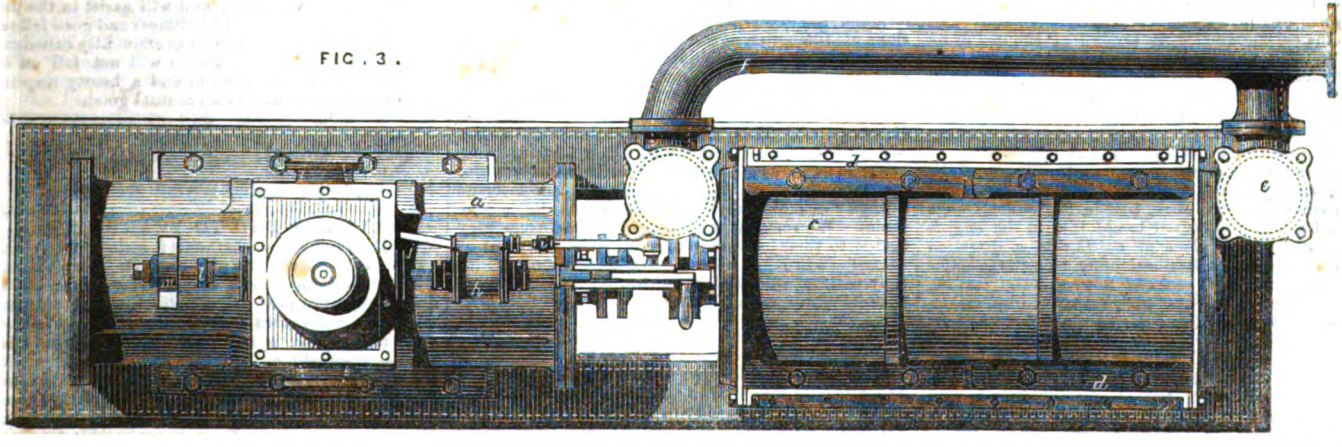

COAL-GETTING MACHINERY.

IF there is any one thing more than another through which we may lay claim for consistency during the existence of our journal, it is that of doing what we could to popularise the subject of coal-getting by machinery, and thus to alleviate the sufferings of the "black diamond getters" in their toils underground. Nor do we know of any one among the many who have entered this field as inventors who have shown greater perseverance and better deserved success than does James Grafton Jones, of the Blaina Ironworks, near Newport, in Monmouthshire. This gentleman has just come forth with a fresh patent for "Improvements in Machinery used for condensing atmospheric air, and in Machinery worked by compressed air, employed in getting coal, stone, and minerals," which we have this week partially illustrated, and are now about to fully describe.

For the purpose of condensing atmospheric air, the piston-rod of a reciprocating steam-cylinder is con-

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nected to and works the piston of the air pump, the length of stroke of each piston being the same. The two cylinders (steam and air pump) are both fixed on the same bedplate, by which they are readily retained true to each other, the two end covers of the two cylinders where the stuffing-boxes are constructed, and through which the piston rod works are as close as may be together, simply allowing room to get at the two stuffing-boxes. The piston-rod does not pass through either of the covers at the other end of the two cylinders. The air-pump cylinder is contained in a trough or vessel, so that such cylinder may be constantly surrounded by cold water continuously supplied to the trough. The relative diameters of the two cylinders will depend on the pressure of the steam used in the steam cylinder and the pressure to which the air is desired to be compressed. The use of a fly-wheel and shaft are dispensed with, and the change of motion of the piston in the steam cylinder is obtained by tappets or spindles which pass through stuffing-boxes formed in the two end covers of the steam cylinder; the tappet at each end of the steam cylinder is at its outer end pin-jointed to the shorter end of a lever, which by its other end, by means of a connecting rod, gives motion to a slide valve. By this arrangement, as the piston arrives nearly to the end of its stroke it pushes out the spindle or tappet at the end of the cylinder, and the position of the slide-valve is quickly reversed. At each end of the air-pump cylinder are valve-boxes, in each of which is an induction and an eduction valve, which it is preferred should be circular, spindle-valves resting by their outer edges on rings of soft elastic matter as valve seats. A starting and stopping hand lever is applied to one of the axes of the levers which work the slide valve of the steam cylinder. The outlets of the two valve-boxes of the air-pump cylinder are connected together by a pipe, to which is connected the supply pipe to the engines or machines worked by compressed air. When the engines or machines are necessarily distant from the air-pump, two or more air vessels are employed in connection on the supply main, and for this purpose cylinders or other forms of vessels are introduced at intervals along the supply-main or pipe of such dimensions as may be desired, and depending on the size and speed of working of the compressed-air engine which is actuating the picks used in getting coal, &c.; by these means the supply of compressed air to the engine may be more advantageously made than when a long length of supply pipe or main intervenes between the pumping machinery and the compressed air engine without such enlargements or reservoirs. Heretofore the machines or engines worked by compressed air or other fluid used for actuating lever picks when getting coal have been arranged to be moved along the face of the work, and to cause the cutting points or edges of the lever picks to strike against the outer surface and move inwards to the depth desired. Mr. Jones now arranges these machines in such a way that the edges of the lever picks used begin to act on the back of the material and move outwards, so that when the pick has completed a cut it shall be out of the working, and require to be moved back into the working before it makes its next cut: by this means lever picks will be less liable to be held in the workings than when the point or cutting edge penetrated more and more into the solid mass till it arrived at the end of its stroke. For this purpose the lever picks are held by the machinery, and are worked in a reversed position, and in commencing to work a chase or cut is first made by hand or otherwise to the depth desired for such a distance as will admit of receiving a lever pick into it, and at the same time allow of its cutting edge commencing at the back of the work, and to cut outwards, completing its cut at the outer surface of the work, that is, the cutting edge of the lever pick is caused to cut toward the engine which works it, in place of cutting in a direction from the engine, as has heretofore been the practice when working lever picks by like engines. Having selected the engine and air-pump for illustration, we will now proceed to describe them.

Fig. 1 is a side elevation, Fig 2 a longitudinal section, and Fig. 3 a plan of an engine and air-pump constructed and combined according to the invention of Mr. Jones. *a*, *a* is the steam cylinder, having within it a piston *a*, the piston-rod *b*, of which gives motion to the piston *c*, in the air-pump cylinder *c*, *c*; these two pistons are shown to be of nearly the same diameter, but the relative diameters of the pistons of the steam cylinder and air-pump will be varied according to the requirements in each case. The air-pump cylinder is contained within the trough or cistern *d*, *d*, in order that it may be subjected to the action of cold water supplied to such trough or cistern. The air-pump cylinder has a valve-box *e*, *e*, at each end connected together by a pipe *f*, *f*. In the arrangement shown the two tappets, *g*, *g*, are arranged to be one actuated by the steam cylinder piston *a*, whilst the other is arranged to be acted on by the air-pump piston *c'*, which is the arrangement preferred; but if desired, both tappets *g*, *g*, may be arranged to be acted upon by the steam piston *a'*, or both may be arranged to be acted on by the air-pump piston *c'*. The tappets *g*, *g*, have a hand lever *g'*, by which the tappets may be moved when required, and such hand-lever *g'*, gives motion to the slide of a small steam engine *h*, by the rod *i*, which at one end is pin-jointed to the lever *g'*, and at its other end is pin-jointed to the cranked lever *i'*, which gives motion to the slide-valve of the small engine *h*. The hand-lever *g'* has also a stud on it which works in slotted links connected to the end of the spindle or stem *j*, of the slide valve *k*, of the steam cylinder *a*, *a*, by which, in the event of the valve of the small steam cylinder *h*, not acting correctly, the slide-valve *k*, of the engine *a*, *a*, will be moved by the hand-lever *g'*. The piston of the small steam cylinder *h* is on the spindle or stem of the slide-valve *k*, and there are stops *l*, *l*, on the other end of the valve spindle, which act against elastic packing in the standard *m*.

In carrying out the second part of the invention, air vessels are placed at intervals—says about every 80 to 100 feet, or at any other desired distances apart. These air vessels the inventor prefers to be of about the same length as the air pipe, which is usually about 4 inches in diameter and about 9 feet length, whilst the air vessels are about 12 inches diameter; but these projections may be varied. The object of this part of the invention is to have such a supply of condensed air near where the working of the picks is taking place that there may be a full supply of air to the condensed air engine or engines working the picks, so as to prevent as much as may be wiredrawing of the air through the supply air mains between the workings and the air-pump.

In conclusion, we wish Mr. Jones every success possible, and that we may long have to congratulate him on his progress.

POWER REQUIRED TO DRIVE MACHINES.

One of our correspondents writes us:—I should like to get a table giving the number of horse-power required for the different sizes of circular saws," and we have no doubt that many persons who are about to start machinery would like to know what sized engines it is necessary to provide to drive their machines For the benefit of these persons, we should like to collect a large number of facts in reference to the power employed in driving different kinds of machinery, and if any manufacturer, superintendent, or engineer, will send us a statement of the facts in his own case, we will, if approved, publish it, thus making our paper the medium for collecting and disseminating a great mass of knowledge in regard to this important matter.

Where an engine is employed we should like the diameter and stroke of the piston, the point of cut-off, and the average pressure carried; the dimensions of the boiler would also be interesting; then a statement of the machinery driven. Where machinery is driven by water power it would be of no interest to learn anything in relation to it unless enough can be known to enable the horse-power to be computed. This would require the height of the fall, and the quantity of water, either in pounds or cubic feet, passing through the buckets in a minute. Where this can be furnished, then a full description of the machinery in motion would be acceptable. We suggest that many manufacturers may find it to their interest to forward us a statement of these facts in relation to their establishments, while they will, at the same time, be disseminating very valuable information.

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THE ancient Greeks used a mixture of salt, nitre, and alum when melting their gold, by which substance the silver was also purified. It is not improbable that lead was also added to promote the flux of the metals.

TO OUR READERS.

We have, at the very moment of going to press, received a letter from the solicitor of Messrs. Holtzapffel, the Engineers of Charing-cross, accusing us of pirating from their work on "Mechanical Manipulation." We need scarcely inform our readers that we were, up to the time of receiving the letter, in ignorance of such piracy. We consider Holtzapffell's work the leading authority for amateurs, and have often quoted it as such. Indeed, at page 148, in our last number, we inserted a letter from a correspondent, asking when the fourth volume of the work would appear. We have always endeavoured to inform our readers from whence we gather our information, that they themselves may search and read more fully, and, although as yet in ignorance as to the correctness or extent of the charge against us, we can but express our willingness to apologise if we have been led into error by any too eager contributor.

December 21, 1865.

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OUR CHRISTMAS NUMBER.

IN announcing his intention to publish an enlarged Edition of THE ENGLISH MECHANIC as a Christmas Number, TO BE ISSUED ON THE FIRST TUESDAY IN JANUARY, WITHOUT ANY INCREASE IN PRICE, the Proprietor respectfully submits that he thereby affords the many thousands of readers and numerous contributors an opportunity of each contributing a something as a Christmas and New Year's Treat for his fellows—some little "trick of trade" (in the good and true sense of the word); some improvement in tools, anything, in fact, which may be of value to brother workmen, and will assist in the promotion of feelings of kindliness and good fellowship, which the season is so eminently calculated to call forth. The Editor will not fail on his part, and will be glad to find a hearty response to this challenge to do mutual good.

The English Mechanic.

FRIDAY, DECEMBER 29TH, 1865.

YEAR'S END TO YEAR'S END.

WE do not know whether it is strictly "mechanical" the wishing of our readers, most heartily, a Merry Christmas and a Happy New Year; but we are willing to run the risk of being thought extremely unprofessional in this item, as we seek in it to cultivate that which is so much wanted all the world over—good feeling. During all the year now closing we believe artizans in general have met with remunerative employment; and the various tests—banks and societies which exist principally from and through the working masses, tell a very favourable tale. Our trades have not been "sewn up" by foreign competition; and the importation into this country of various kinds of fancy goods has now almost ceased, simply because their importers have found that they were doing something very much like carrying coals to Newcastle. For this we are indebted to Mr. Gladstone and free trade; for it was this set manufacturers to work in the improvement of machinery,

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and the encouragement of talent in designing. True, for a while it seemed as if we were simple playing into the hands of the foreigner: we know better now, and are beginning to thank the great disciple of "goodwill to man," who could not be mentioned or complimented at a more fitting season than the present.

During the year past we have made the acquaintance personal and by letter, of nea ly every one of our readers; and, we say it advisedly, we doubt if ever editor had a more intelligent class of correspondents address him. We trust we have been found equally valuable as acquaintances to all who weekly deposit their penny at our publishers' or agents,—it is not without our endeavouring hard to make ourselves so. Searching their own experience our reader will recognise the truth of the saying that it is a very hard task to please everybody—in fact it is an impossibility. But we are getting better acquainted with each other—Readers and Editor,—as we hope still better to be; and in this hope—and looking back with thankfulness on the year passing away, and with hope to that now about to make its *debut*—we again cordially wish all our readers, gentle and simple, a hearty Christmas and a prosperous New Year!

BOILER EXPLOSIONS.

OUR attention has been called to one or two recent fatal boiler explosions, in the coroners' inquests over which, in the face of, to us, most convincing evidence to the contrary, verdicts of "Accidental Death" have been returned. It is almost needless to say that these boilers had been under the inspection of no association—in fact, we are told that neither of them had been inspected from the date of their erection—and one of them had been at work almost day and night for ten years! Where, we ask, in answer to our correspondents, is the use of our devoting space to full records of such unfortunate facts. Papers many years of age have been at it ever since their commencement, and have given it up in despair; and the only hope we see for those who, unfortunately, have to work in proximity to such boilers, and such thick-headed employers as use such faulty constructions, is such a spread of knowledge among all classes as will lead to a more intelligent inquiry both by coroner and jury, and, consequently, the alteration of the verdicts to "Wilful Murder." We are perfectly well aware of the fact that there are certain districts in this free country where truthful evidence on such a subject *dare not* be given. There is a remedy which Government might apply, and that is the production half-yearly, to the clerk of the peace, of a certificate, signed by a qualified engineer-inspector, that such and such boilers had been inspected and found sound—a very heavy penalty being attached to working steam from a boiler which had no such certificate. The remedy is a very simple one—when one of the Royal Family, or a big duke, gets thus "accidentally" killed, we may look for some such law being passed. As things go, this seems the only chance. It is very sad—it is none the less true.

TRANSFER ENGRAVING.

WHILST the articles on hardening tools, &c., were passing through the press, almost as a matter of course, we had various inquiries respecting the Perkins' admirable process of transfer engraving, which we now proceed to answer by describing the process.

A soft steel plate was first engraved with the required subject, and then the plate was hardened. A decarbonised steel cylinder was next rolled over the hardened plate by powerful machinery until the engraved impression appeared in relief, the hollow lines of the original becoming ridges in the cylinder.

The roller was reconverted to the condition of ordinary steel and hardened, after which it served for returning the impression to any number of decarbonised plates, each of which becomes an exact counterpart of the orignal. In the event of an accident to the roller, the original plate still remained.

To decarbonise the plates, they are placed vertically in cast-iron boxes, at least ¾ inch thick, and surrounded on all sides by a layer of iron filings half-an-inch thick; the boxes are then placed in a furnace, and, after being heated, suffered to cool in the most gradual manner by shutting off all air, and covering the boxes with a 6 or 7-inch layer of cinders. The re-conversion was similarly accomplished, but with the charcoal from leather sifted fine; and on removal fron the boxes at the end of four or five hours, the plates are plunged vertically into cold water. Thin steel plates are annealed at a higher temperature, in earthenware boxes filled with oyster shells. Good practice is to anneal at one time four cast-iron boxes, each holding from three to six steel plates, surrounded on all sides with fine charcoal, mixed with an equal quantity of chalk, and driven in hard.

The reverberatory furnace employed has a circular cast-iron plate, or bed, on which the boxes are fastened by wedges, and as the plate revolves very slowly (by the engine), the plates are exposed in the most equal manner to the heat, and when the proper temperature is attained all the apertures are carefully closed, to extend the cooling over 48 hours. The surfaces are thus rendered exceedingly soft to the 1-32nd of an inch; the device is raised in the transfer press under a pressure of some tons; and the plates are hardened without any intentional application of the case-hardening process, as the simple steel is superior to that which has been "treated." The plates are used in the soft state.

In hardening engraved plates, rollers, dies, and similar works, it is of the greatest importance to preserve the surface unimpaired, and, as steel is very liable to oxidation at the red heat, if exposed to the air for even a few seconds, and which oxidised scale will often nearly remove, or, at any rate injure the engraving; it is of the utmost consequence to conduct the heating and cooling with the most complete exclusion of air.

Oldham's process, from which the plates issue having the beautiful tints of case-hardened gun-locks, is as follows:—The work to be hardened is enclosed in a wrought-iron box with a loose cover, and a false bottom, and with three ears projecting from its surface about midway; the steel is surrounded on all sides with carbon from leather, driven in hard, and the cover and bottom are carefully luted with moist clay. Thus prepared, the case is placed in the vertical position in a bridle placed across a great tub, which is then filled with water almost to touch the false bottom of the case. The latter is now heated in the furnace as quickly as will allow the uniform penetration of heat. When sufficiently hot it is removed to its place in the hardening tub, the cover of the iron box is removed, and the neck or gudgeon of the cylinder is grasped, beneath the surface of the carbon, with a pair of long tongs, upon which a coupler is placed and "fleeted" down, as the sailors phrase it, to secure the grasp. It only remains for an operator to hold the tongs whilst a smart tap of a hammer is given on their extremity; this knocks out the false bottom of the case, and the cylinder and tongs are instantly immersed in the water; the tongs prevent the cylinder from capsizing and injuring its contents. It is believed by many that steel plates are reduced to their softest state by enclosure with lime and ox-gall.

SCIENTIFIC NOTES.

M. Schrotter has reported to the Academy of Science of Vienna that he has successfully employed the light produced by the combustion of magnesium in the exhibition of the phenomena termed fluorescence, due to the very large amount of chemical rays which it possesses, and which renders it efficacious in the operations of photography. He found, by experiment, that dry chloride of silver assumed a blue colour when exposed for a few seconds to the magnesium light; and that platino-cyanide of barium showed great sensitiveness. Several bodies which become phos-phorescent after having been exposed to sunlight during eight or ten minutes acquired this property after exposure to the magnesium light for a few seconds only.

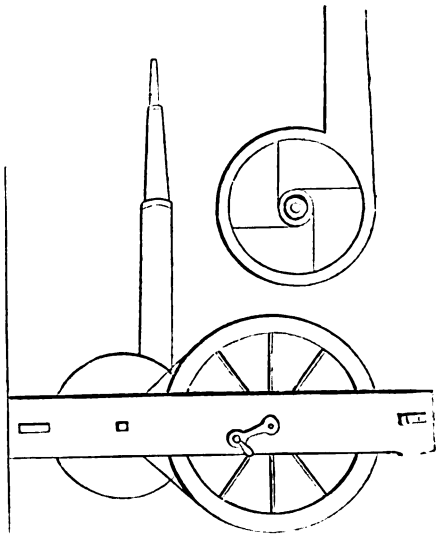
M. A. Bechamp, in the conclusion of a note on the physiological exhaustion and vitality of yeast, read at a recent meeting of the Academy of Sciences at Paris, states that the results of his experiments are contrary to the opinion of Mitscherlich, who thought that the globules of ferment, well washed with water are entirely deprived of their property of acting on cane-sugar. M. Bechamp asserts that this yeast still continues to act on cane-sugar, since it has not ceased to live; and that, when it is so exhausted, it is simply reduced to its cellule, and wi l yet form grape-sugar and alcohol from sugar-cane. "The property of creating fermentation," he says, "is not to be sought in the catalytic action of some chemical ompound which it may contain; it dwells—and everything seems to prove it—in the properties of the living cell; it is a consequence of the act of the nutrition of this cell." These conclusions are contary to the opinion of Liebig, who says:—"The insoluble body termed ferment does not provoke fermentution."

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

FORGING FAN.

Sir,—I beg to hand you a sketch of a small forging fan that I have found exceedingly useful, and which costs but a trifle. It is well suited for an amateur turner, being quite powerful enough to forge an inch bar of steel, or to weld half-inch iron.



It consists of a wooden wheel two feet in diameter, the fan is of tin plate, also the tuyere, except the nozzle, which is ⅛ inch iron. The cost is about 10s., without reckoning my time.

I want to know how to turn iron rods 1 foot long and 3-16th diameter? T. T. PARKINSON.

THE EXCHANGE.

Sir,—I am glad to find by the editorial note in the present number that your contributors are sensible of the advantages of a medium of exchange in their various pursuits of what is superior or unique for something of equal estimation.

The practice has long existed among naturalists, who exchange their surplus specimens of insects, butterflies, &c., for others they do not possess, and thus enlarge and add to the value of their general collections, and the acquaintances which often spring from these courtesies increase the charm of the study. Why not the same results in mechanic and other sciences, by which associations will be formed with those of kindred taste, infusing fresh interest in the pursuit of knowledge. They inspire with the hope of success, and invigorate those powers which must be exerted to attain it. The spark which kindles a train of light is sometimes struck out, and amidst a multitude of attempts some effort more happy than the rest elicits an important discovery.

These remarks apply, of course, only to amateurs, because professionals in any line will retain what they produce, if superior or unique, to enhance their own reputation and profit. I consider the idea is good in itself, and calculated also to add to your own interest, influence, and usefulness. THOS. WILLIS.

SOLDERING AND TINNING.

Sir,—Your table of soldering materials and process is exceedingly good; but you will find that zinc will solder best with pure muriatic acid, a single drop causing the solder to take instantly.

There is another difficulty in soldering large articles which I suggest for the information of your readers, where the copper bit is not heavy enough to overcome the thickness of the metal about to be soldered, which may be overcome successfully by partially heating the articles over the forge, and then applying the copper bit. A mere warming is sometimes sufficient.

Will any of your correspondents inform me of the process and ingredients employed for the tinning of cast-iron saucepans and other cast-iron work? NIMROD.

RAILWAY SIGNALLING.

Sir,—Having frequently read of railway accidents, such as one train coming into contact with another on the same line, and having read also of the schemes that have been proposed for the prevention of the same, and of their failure, I venture to propose a system of signalling, which would effectually prevent such calamities, unless through the negligence of the driver, or other attendants, or through the s gnals being out of order.

The enclosed drawing is the system of signalling I propose. The signals will be worked by electricity or other equivalent, and set in motion by inclined planes, and anti-friction rollers, from the engine or break van (break-van preferred, so that no accident could occur if the carriages became uncoupled). For instance, the train upon leaving the station, and in passing the first signal post, would raise the signal to indicate danger; and in passing the second signal post, would do likewise; and in passing

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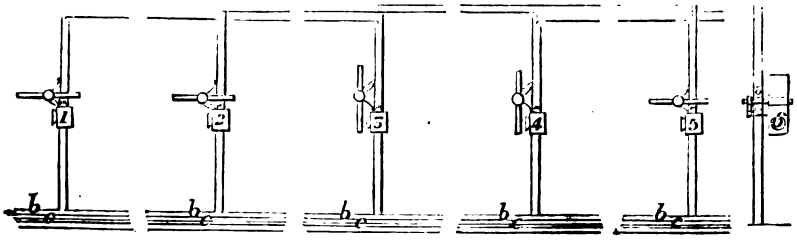
the third would also raise the signal; but, at the same time, would depress or replace the signal of the first signal post; the fourth, that of the second (as shown in the drawing where the train has just passed the fourth post), and the fifth that of the thrird, and so on, so that there would always be at least the distance between two signal posts for the drivers to stop the trains, so that it is obvious that no accident could occur unless through the causes previously mentioned—the signals would, of course, be placed at suitable distances.



In the drawing, *a*, are the electric wires; *b* the inclined planes; *c*, the rails. No. 6 is an end view of the signal-post, with signal turned for danger.

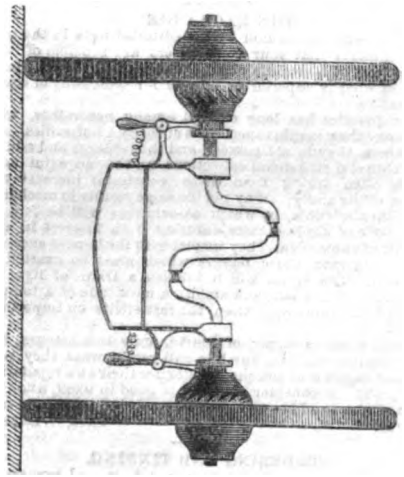
The other systems of signalling have, I believe, failed, because the second signal depressed the first, the third, the second, &c.

I thank you for publishing my design in your paper of the 15th inst., and I hope you will oblige me by inserting this, as it is obvious that no accident can occur unless through negligence; or, unless the signals were out of order. CHRISTR. J. LITTLE.

The "Exchange."

VELOCIPEDE

Sir—As you have been so kind and liberal in your proposition, I think it is the duty of all subscribers to give a push at the wheel. As far as I can assist I will; but, if ever I should pay London a visit, you will have no occasion to fear I shall set fire to the river. Now to the point, that is the velocipede. If I was to make one, I should not like to feel lame on one side, so I propose using a pair of face ratchets to form a clutch joint, one cast on the nave of each wheel, the others to work loose on and with the main square driving shaft held in place with a lever in a grove, and a light spiral or elastic spring to keep them in place



when at work; but when required for wheels to work loose on shaft, the levers are pushed out, and held with a catch; a pair of ratchets will be required for each hand. Let it be remembered the wheels run on a round part of shaft, so that in turning to right the left wheel slips over a tooth or two, and the same on the other hand, and running in a straight line, both are driving wheels, and a steady run is obtained. I send you a sketch—if you think it worth the trouble and expense of insertion. G. W. WALTON.

OUR SUBSCRIBERS' NOTES AND QUERIES.

Will your correspondents throw some light on the following:—

In Dempsey's "Tubular and Iron Girder Bridges" he gives the contents in the formula for calculating the transverse strength of beams:—

For cast-iron	2548 value of S.
Wrought iron	2050 do.

Formula $S\,b\,d^2 = l\,w$.

S, as shown; b = breadth in inches; d_2 = depth; l = length in feet; w = weight in pounds

He also gives the tenacity of wrought-iron, 27 tons; cast-iron, 8. Resistance to compression, wrought iron, 54 tons; cast do 48 pounds.—ASPIRANT.

ECCENTRIC CHUCK.—Will a correspondent say what form of work the eccentric chuck is adapted for, also if the ring is used same as for an oval chuck. Is it possible to turn an oval (say one or two feet in length) when it has to be supported at both ends, and the means with ordinary centre and oval chuck? It is round at one end, and oval at the other.—D. HALL.

PIERCING STEEL.—Can you or any of your readers tell me the best method for piercing cast-steel?—SAMUEL JELLEY.

METAL.—I wish to know if there is a metal for a plug which will resist the action of the acid which is in tallow, and which will also resist the heat of steam?—METAL PLUG.

VELOCIPEDE.—Will some correspondent inform me the price of a double velocipede, first or second hand, and the best place to obtain it? Also, the prices of lenses for astronomical telescopes of the powers 300 and 600?—GLADIATEUR.

MAGNESIUM.—Will some reader kindly inform me the simplest process by which the metal magnesium is obtained?—B. V. HARLEY.

Can any one tell me how to enamel wood, the grain to show the same as if French polished?—FORWARD

GILDING.—Con any kind correspondent tell me how to gild wood, and how to make the bases of glass shades (wooden ones I mean) imitate ebony and marble? A good imitation I want, of course.—PARIAN.

CUTTING SCREWS.—I should like to ascertain if there is any machinery made for cutting external and internal screws in wood, and if so, the maker of such machinery?—X. Y. Z.

TRACING PAPER.—Can any reader oblige me with a good receipt for preparing tracing paper; also carbonic or black tracing paper?—J. H. RAVEN.

ELECTRO MAGNETIC ENGINE.—Will Messrs. Tonkes, Electra, Furze, or any other of your electric correspondents, tell me what arrangement of battery, and what form of magnet is most powerful, lasting, economical, and compact, for the purpose of working an electro-magnetic engine?—CORN PULLEY.

MAGNETIC.—Will any correspondent kindly furnish me with the best method of magnetising a bar of hard steel six inches thick and two feet long? and also, how I can tell when the bar is fully saturated with magnetism? In the autumn I saw at Ostend two bar magnets about this size, but composed of steel plates screwed tightly together. They were suspended by ropes that passed through a hole in the centre, and some inches apart from each other. The power of these magnets was so great that it required more than the strength of one man to bring their similar poles into contact.—R. W. WILLIS

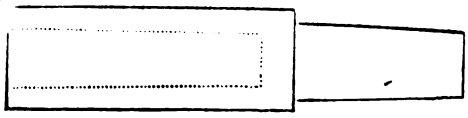
MICROMETER.—Having finished a fine objective metal of about 18 inches aperture, and 10 feet focal distance, being desirous of mounting it as an equatorial, I should feel extremely obliged to any scientific gentleman who would give a working description of a double position micrometer? also, general outline of the equatorial stand of Mr. Lassells, or the heavy reflector in the Glasgow Observatory?—T. W. B.

REPLIES TO QUERIES.

MANDRIL BINDING.—In reply to A Turner, I can give no explanation as to the cause of his mandril binding while he is at work, without it is, that his mandril is taper, and without a shoulder. Now I have made them in a great many forms, but find the following kind the best for work and wear:—

Of course the collar is made to fit up to the shoulder on mandril, if A Turner's mandril is taper, with no shoulder, the sooner he gets a new one the better.—W. H. PEARCE, lathe and tool maker.

CHUCK.—A correspondent, some little time ago, asked for a chuck for turning brass rods. One or two kinds appeared in your excellent little journal, but as I think that mine is better than any you have published, I beg leave to submit it to your notice. Take a piece of mild steel, and turn it to fit the lathe spindle like an ordinary centre, and bore a taper hole up the centre for about an inch, taking care that the hole is less than the rod, when the taper drill is put in, the hole should taper 1-18th to an inch in length; this will be found very handy for turning any small work that can be finished before taken out of the lathe, such as straight and taper pins for collars on shafts, &c., and the brass rods your correspondent mentions.—ALPHA.



P.S. I should be very much obliged to any of your numerous readers if they would kindly give the rule for finding the weight of blow given by steam hammer.

BRONZING.—In answer to Chang's enquiry at p. 124, No. 37, I think that he had much better take his coffee pot to some one in the trade, as there is little hope for his success in attempting to do it himself, but I will give him an idea of the way to set about it; the first thing wanted is a forge, without which he can do nothing; presuming he has one, he must take the pot all to pieces, wiping off all the solder with a wisp of tow, and taking care not to let any of the metal in the fire, (for in the trade no metal is allowed on the forge where bronzing is done), then twist a little tow on the end of a stick, and pickle with "spirits of salts" all those parts that are tinned, pickling the outside as well as the in, rinse in water, and scour outside with wisp of tow and sand, fine coke dust is best for the tinned parts, which must be brought quite clean, rinse clean, smear the outside with wet whitening, and then tin with bar tin, sal-ammoniac being the best agent, and if he wants the inside to look nice, it must be wiped out dry so that none of the tin is left to run, then pickle only the outside with diluted spirits of salts, rinse, and scour with clean sand till the surface is perfectly clean and bright, taking care to rub as much as possible in one direction (tinning may not seem necessary, but if not done the old tin on it will be burnt off in bronzing. The cast parts, and those not tinned (if any) are pickled in dilute oil of vitriol, and scoured with sand, same as the body, and beat with a brush, then dried in sawdust, and is now ready for bronzing. Procure some crocus (which is an oxide of iron), and some knowledge is wanted to select a good one, as it may be too light, or too dark, or too fine, or too coarse, then make into a thick cream with water. Having used the fire to tin with, to be on the safe side it is best to rake out all the old coke and light afresh, and the coke should be a nice, clear, firm, grey ore, and broke in pieces the size of a walnut, you must also have some nice clear, bright coal, then blow up a clear bright fire, and heap up plenty of coke that the sulphur may burn off, now take a little of the mixed crocus, and brush up the body, using a hard brush, get all the crocus off clean, and wipe with a clean piece of rag, and it is best to hold with this, as the perspiration of the hand will prevent the colour taking; now blow up fire, making a hole in centre, so that a good blast comes up, and having painted the body, evenly, so that the colour does not run (a flat camel hair brush, 2½in. wide, is the best thing to do it with), hold it with the tongs and turn it steadily so that all parts are exposed fairly to the blast. As soon as it is dry, throw into the fire a bit of coal about the size of a Spanish nut, more or less to size of work, and let the work have an even coat of smoke till it is quite black, but no more (if the coal is not burnt out hold the work on one side), then turning it steadily, keep up a sharp blast till the smoke is burnt off, then stand it to cool. Treat cast parts the same, but as soon as the smoke is burnt off, dip them into clean cold water, else, on account of their thickness the colour will burn, when cold, wipe the crocus off the body with wisp of clean tow, then brush hard till quite clean, wipe with rag and repeat the above once or twice, according to the shade required (to finish properly the body is hammered all over with bright hammers shaped to parts, and on suitable tools which are covered with 2 or 3 folds of lasting), the inside is scoured bright, and the parts soldered together, using resin. This is the process to which coffee-pots and urns have to be subjected, and Chang will see that it is one requiring some amount of practical knowledge. B Kingsland, p. 136, no. 38, wants to know how to bronze medals; he is answered by the above. Medals only want brushing up with wet crocus, taking care not to touch with hand, and then colouring as above. Only copper coins can be so bronzed.—GIVE AND TAKE.

SAFETY VALVE.—I find in answer to J. M. S., that his safety valve, as already loaded, would begin to blow off at 63·69lbs, and that to blow off at 60lbs, the weight would require to be placed 8·12in. from the fulcrum.—SHEFFIELD.

GUN BARRELS.—In answer to Cina, who seeks information respecting the boring of gun barrels, I beg to inform him that the barrels are first firmly fixed in a clamp, having a leg to it, the leg is then inserted in the cup or socket of a sliding frame, which frame slides on a bed, either flat or two V's, or occasionally runs on wheels in grooves, and after the barrels are nicely adjusted to the centre of the boring shaft, a square broach about 12 inches long having a long shank to it, is inserted in the barrel and packed on one side (not on all four, as your article on Broaches, in No. 37, affirms), with a wood spill and paper, to fit the bore of barrel. The shank of the broach having been attached to the shaft, it is turned by means of a crank and fly wheel or steam power, and the frame containing the barrels is drawn forward as the broach cuts by a rope which is attached to it, passing over pulleys, and having a weight at its extremity. If Cina requires any more information, if he will forward you his address, I will communicate personally with him. Can any correspondent inform me how glycerine and nitric acid is prepared for blasting purposes, whether there are any other ingredients with it, and in what proportion they are mixed?—SOCRATES.

THE BOILER QUESTION.—I feel pleased with the manner which your correspondent A. Nelson has defended his boiler, and the good spirit manifested throughout his remarks. But some remarks he has made I should like to correct. He says, I do not understand the system of his boiler; now my objection was, that it did not possess the essentials of mechanical constructions, simplicity, and efficiency. Your correspondent sought by complicated means what was in his reach by simple ones. He says, that I prefer thick plates, quite a mistake; I prefer thin ones, and for that end would have weld boilers, by which means I would secure the greatest strength with the least material; and all advantages arising from a truly circular boiler, and absence of longitudinal joints and rivets. I am aware of the action of the flame on thick plates, but the boiler under discussion is an internally fired one, and the flame can only affect the flue, and that we have discussed previously. As to the objections to punching thick plates, the holes are farther from the edge, so that it amounts to the same thing,

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and I find it to be so in practise. Concerning corrosion, there are so many theories that it would take too long to discuss them now; but it is best to remove all facilities for corroding as far as we possibly can. And, I may assure our friend, there is no difficulty in making a perfect weld. In reply to Robert Jenkins, I prefer the cross tubes as attached to the boiler by Mr. Galloway, the patentee, for the reason that when furred up, and consequently injured they are so easily replaced. Wishing you every success in your efforts to diffuse knowledge and enable men to attain proficiency in their profession.—ASPIRANT.

PRESSURE ON CABLE.—Atlantic Cable wishes to know what amount of pressure the Atlantic cable sustains in depths of 30, 100, 1,000, and 5,280 feet. Rule:—Multiply the depth in feet by ·434, the product will be the pressure in lbs per square inch. Example:—1,000 × ·434 = 434 pounds, the pressure at a depth of 1,000 feet.—W. H.

FRET SAW.—In answer to Butt Joint, I have to say that my fret saw will cut a 4-inch thick piece of hard wood, with the slow motion of the lathe, the saw then making about 120 cuts per minute. The length of the long arm of the eltow lever is 18in., of the short arm (from centre to centre), 7 inches. With respect to the figured details, I will send next week full descriptions and drawings of a much simpler fret saw, which I have just completed. I hope this will also suit Mr. Herbert; but I can say of both these saws, that I work them on my lathe, (7in. centres) with ease.—THOS. E. MERRITT.

VELOCIPEDE.—In reply to N. J. W., the entire wheels of velocipedes are very strong and light when made of oak, ¾ inch thickness of felly at the part where the tire goes on, 1 inch thick where the spoke ends are entered, and 1¼ inch deep.—T. E. M.

JAPANING TIN.—In No. 39, in Notes and Queries, B. Hickman wishes to know the process of japanning tin trunks. If he will send me his address, I shall be very happy to give him the information he requires.—FLANDERS OWEN.

IRIDESCENCE.—I thank your correspondent for the information given about iridescence. But I find there is another way of producing it by the aid of varnish, which would better answer my purpose. I am informed that it is done in the following manner:—

The fundamental tint of the surface to be ornamented is laid on. A beautiful principle in optics is next brought into play—no colour is employed to produce the opalescence; the soap bubble exhibits its beautiful hues, although the water is nearly colourless, and so likewise it is in the present case. When a film of any transparent substance so thin as a twenty-thousandth or a fifty-thousandth part of one inch, there occurs what philosophers call an interference of light at the two surfaces, which produces colour, and this colour depends upon the thickness of the film, and the angle at which it is viewed. Each surface is covered by a careful process of dipping with an exceedingly thin film of a peculiar varnish, the process and the varnish being so chosen as to produce opalescence or iridescence.—W. F. O.

BRONZING.—In answer to B. Kingsland, I send the following, taken from Charles Tomlinson's "Cyclopædia of Arts and Manufactures":—Copper coins and medals may be bronzed by the following process:—Dissolve in vinegar two parts verdigris, and one part sal-ammoniac; boil, skim, and dilute the solution with water until it ceases to let fall a white precipitate. The solution is then made to boil briskly, and is poured upon the objects to be bronzed, previously made perfectly clean from grease, and set in a copper pan, which is to be put on the fire and the boiling renewed. The pieces must be so arranged that the solution may be in contact with every point of their surface. The copper thus acquires an agreeable reddish brown hue, without losing its lustre, but it is necessary to inspect the articles every five minutes, and to remove them from the solution the moment the desired shade is attained. The pieces must then be washed repeatedly with water and carefully dried; if the solution has been too strong, the bronzing will come off with friction, or turn green by exposure to the air. An antique bronze appearance may be given by dissolving one part sal-ammoniac, three parts cream of tartar, and six parts common salt, in twelve parts of hot water. This solution is to be mixed with eight parts of a solution of nitrate of copper, specific gravity 1·160. When this compound is applied repeatedly in a moderately damp place to articles of bronze, it gives them a durable green coat which gradually increases in beauty; by increasing the proportion of common salt, a yellowish tinge is produced; by diminishing it, a bluish cast is obtained. A large addition of sal-ammoniac hastens the process.—F. W.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

J. D. D. W.—We have enquired, but cannot learn.

D GREIG.—Thanks.

WRIGHT JONES.—Supposed to protect for three months, but a mere sham.

ENGLISH MECHANIC.—Received.

SOCRATES.—You are right. The repeated blunders are disgraceful.

HORATIO BOOTH.—Yes—they rank as gentlemen.

W. H. G.—One of the best books published, but does not treat upon such subjects.

THOMAS GALE.—Too lengthy.

RISH MECHANIC.—We advise you to stay the full term. It is true that you can leave; but you cannot claim your indentures until you have served the full time.

WILLIAM MORRON.—Refer to back numbers.

MECHANIC.—54, Old Broad street.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

STRENGTH OF CEMENT.

At the meeting of the Society of Engineers, last week, the paper read was on "Experiments on the Strength of Cement, chiefly in reference to the Portland Cement used in the Southern Main Drainage Works," by Mr. John Grant. This communication related to an extensive series of experiments, the results of which were recorded in voluminous tables forming an appendix to the paper, carried on during the last seven years, with a view to insure, as far as possible, that only cement and other materials of the best quality should be employed in the Southern Main Drainage works, of which the author has charge as resident engineer. As a preliminary step, samples of Portland cement were obtained from all the principal manufacturers for the purpose of experiment. The average weight of these samples was found to be 108·6 pounds per bushel, and they sustained breaking or tensile strains at the end of a month, varying from 75 pounds to 719 pounds upon 2¼ square inches. A clause was then inserted in the specifications to the effect that the Portland cement to be used in the works should be of the very best quality, and ground extremely fine, weighing not less than 110 pounds to the striked bushel, and capable of resisting a breaking weight of 400 pounds upon an area of 1¼ inch square, equal to 2¼ square inches, seven days after being made, and after being immersed in water for the whole of that time. The standard was subsequently raised to 500 pounds on the same sectional area, which was that used throughout the experiments. During the last six years 70,000 tons of Portland cement had been used in these works, which extended over a length of eighteen miles, and had cost £1,250,000. This quantity of cement had been submitted to about fifteen thousand tests, at a cost of only five farthings per ton. The machine devised for showing the tensile strain was a lever balance, constructed by Mr. P. Adie, and its first cost was from £40 to £50. It was so simple that an ordinary workman could be trusted to test the cement, and the cost for labour did not exceed £80 per annum for each machine. In conclusion, the author, whilst recommending Portland cement as the best article of the kind that could be used by the engineer or architect, warned every one who was not prepared to take the trouble, or incur the trifling expense of testing, not to use it; as, if manufactured with improper proportions of its constituents, chalk or clay, or improperly burnt, it might do more mischief than the poorest lime. Further experiments were desirable, on the strength of adhesion between bricks and cement, under varying circumstances; on the limit to the increase of strength with age; on the relative strength of concrete made with various proportions of cement and ballast; and on the use of cement in very hot climates, where probably extra care would be required in preserving the cement from damp, and keeping it cool until the process of setting had been completed. On these and other important points the author trusted that all who had the opportunity would record their observations, and present them to the Institution.

NOVEL INVENTION.

Some very interesting experiments took place on Tuesday week on board the *Mersey* screw frigate at Portsmouth, with West's electrical apparatus fitted on board as a warning indicator of possible danger to the ship from fire or water. A ten-cell battery fitted in the captain's cabin, with an indicator dial plate and an alarm bell, is placed in connection with twenty isolated copper wires, each of which communicates with a numbered section of the ship's hold, the latter being set off in twenty sections. Calorimeters connected with each wire are set at a given temperature, say fifty degrees above the normal temperature of that part of the ship, and the ever watchful sentinel for fire is then placed on permanent duty. If the temperature becomes increased from spontaneous combustion, or from a smouldering fire raised by other causes, the temperature has no sooner reached the heat at which the calorimeter has been set than the circuit is completed, the alarm bell violently and incessantly rung in the captain's cabin, and a number displayed on the dial showing the section of the ship in which the dangerous heat is being generated. The rise of water in a ship's bilge beyond a fixed height is also indicated by the ringing of the alarm bell and the display of the section number. The calorimeter is a small metal vessel, some three inches in length, three-fourths filled with mercury. The outside of the vessel is in contact with one part of the copper wire of the section, the other part being suspended through the boxwood stopper in the neck of the vessel, the distance between the point of the latter part of the copper wire and the mercury being regulated according to the temperature considered dangerous. Should this latter event ever occur, the mercury necessarily expands, and, bringing the end of the wire in contact, the circuit is completed. The water signal is a piston enclosed in a chamber with the signal wire fixed at a certain distance—say two feet—above it. If water finds its way from any cause into the ship's hold, the piston rises with the water, and on coming in contact with the wire, the circuit is here completed, and the signal transmitted to the indicator dial and alarm bell. The signals on Tuesday were sent from all parts of the ship with unerring certainty, and with calorimeters set at various degrees of temperature, and with the water signal at varying heights. As the use of fire to raise the temperature of the ship below was out of the question, hot water at the required temperatures was used for testing the system and the manner in which it had been applied on board the *Mersey*. Her Majesty's ship *Valiant* is already fitted on the same principle, which is also to be applied on board Her Majesty's troopships.

OBTAINING MOTIVE POWER.

An invention was previously specified by Mr. Samuel Young, of Manchester (but protection was refused), relating to the production and application of motive power by the means of pressure of weight; and the improvements consist in the novel combination, construction, and arrangement of mechanism for applying the power so obtained to a crank shaft, so as to constitute an engine. The weights are to be applied in the form of ordinary "governor balls," connected to a slide, which presses upon one end of a series of bell crank levers, and so causes another lever to slide or move a cylinder, having a diagonal rib on its surface along a keyway on the crank shaft, which sliding movement causes the ends of two levers to act against the diagonal ribs, so as by their friction to effect the revolution of the cylinder and crank shaft, the opposite ends of such levers also transmitting motion to a sliding block or spring, which is connected by a rod to a crank on the crank shaft, from which the governor balls receive motion. Thus it will be seen that when the power of the engine is beginning to be spent, the weight of the balls, by falling and pressing the levers, maintains the working power. It will at once be seen that the arrangement could not work, because the weights have to overcome all the friction of the machine, and yet, by their fall, to raise themselves again. The refusal of the protection for such an invention is alike advantageous to the inventor and to the public.

PHOTOGRAPHY.

PHOTOGRAPHS ON IVORY, &C.—We notice in a recent list of American patents one by W. H. Smith, of London, for preparing wood, glass, silk, ivory, and other substances for the reception of photographic pictures. No particulars of the method are mentioned.

AN ALLEGED NEW PROCESS.—Mr. Fred Smith, of Leamington, writes to us to the effect that he understands that some one, whom he does not name, but resident in that town, is making claim to the origin of a new process of which he claims to be the inventor. As he does not name or describe the process, we are uncertain as to what he refers. He says:—"I enclose a print, from which you will see that although it is not as yet equal to silver prints, the agents I have used in printing are sensitive to light—the ingredients used by me being vinegar and oil, in proportion to three of the former to one of the latter. The print I enclose is merely printed, being neither toned nor fixed. I intend to make further experiments when time will allow of it. Should any of your readers procure better results I hope they will make it known to the profession." The print enclosed has the appearance of a rich, warm, chesnut-coloured print on plain paper. Mr. Smith has, however, omitted to state the object of the process, or the sensitive material used. The oil and vinegar referred to are doubtless used as the vehicle; but we are not aware that they are sensitive to light. We shall be glad to hear further from Mr. Smith.—*Photographic News.*

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MUCILAGE BOTTLE.

The annexed cut illustrate a simple and effective contrivance for preventing the overloading of the brush of a mucilage or gum bottle, designed by Mr E H. Boswell, of Philadelphia, Pa. The improvement consists of an elastic band of india-rubber, A, applied to the brush and cap, in such a way that a free movement of the brush up and down through the cap is obtained when the brush is pressed upon, but

so soon as the hold is relaxed the brush is lifted entirely out of the gum by the action of the india-rubber spring, in place of soaking into the gum till the next time it is required. This is a considerable improvement, simple though it be, over the ordinary gum bottle in which, when nearly full, the brush becomes overcharged with the liquid, so that a greater quantity than is necessary is smeared over the paper. Here, however, a perfect command of the brush is obtained.—*Scientific American.*

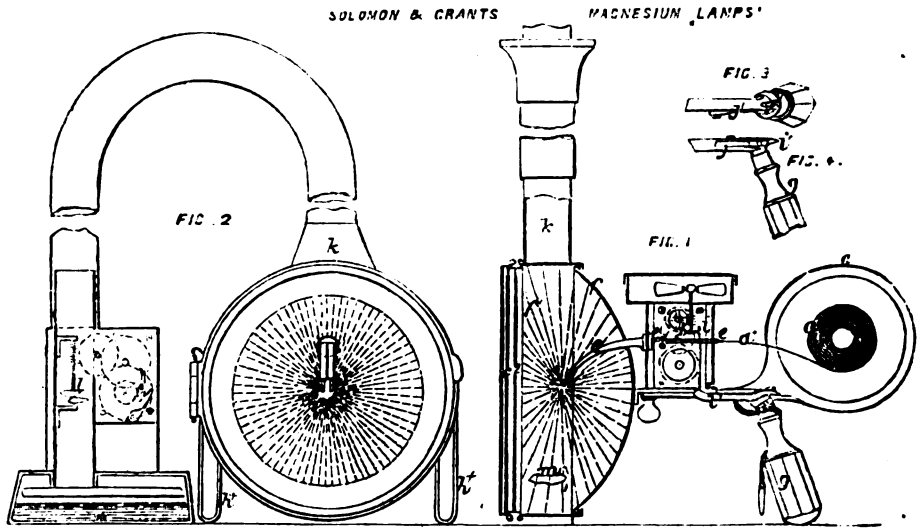
IMPROVEMENTS IN LAMPS, OR APPARATUS FOR BURNING MAGNESIUM AND OTHER METALLIC SUBSTANCES.*

The object of this, the invention of Joseph Solomon, of Red Lion-square, and A C. Grant, of Nottingham, is to feed forward, in a constant and regular manner, the wire which produces the light in magnesium lamps. As the light is produced by the combustion of the wire, and this latter gradually burns away, with a certain and uniform speed, according to the thickness of the wire, the feeding forward of the wire in a regular manner, to a given point, so as always to keep the spark or ignited end of the wire at the same spot, is a matter of great importance.

Fig. 1, is a vertical section of the lamp, and Fig. 2 is a front elevation of the same.

The magnesium wire is wound upon a spool or spools *a*, which are placed in a cylinder a^1, mounted on a stand, on which is placed a box, containing the clockwork movement *b*, which, when in action, draws the wire a^*, off the spools *a*, and passes through a tube *c*, and between a pair of feeding rollers, *d*, *d*, to a tubular holder *e*, from the outer end of which it projects, and, when lighted, burns with an intensely brilliant light. This spark or spot of light may be placed in the focus of a parabolic or other reflector *f*, *f*, so that the light may be thrown forward in any desired direction. The reflector is inclosed in front by a case f_1, provided with a glass f_2, to protect it from currents of air. The whole apparatus is of an extremely portable character, and is provided with a handle *g*, whereby it may be carried or held in any position. This handle *g* should be cranked or bent down, so as to form a foot; so that, with the feet h^*, h^*, Fig 2, attached to the outside of the reflector, three rests, or supports, for the lamp will be formed. For some purposes the spools are dispensed with, and the wire is introduced, at once, to a pair of feeding rollers, which, being actuated by the clockwork, will carry it forward to the point of combustion. The wires may consist simply of magnesium, or of magnesium wire, twisted or combined, with wires or bands of other metal, such as zinc, cadmium, lithium, strontium, barium, or other metals, or alloys with magnesium. These metals, or alloys, when ignited, burn with different coloured lights, as will be well known to chemists and pyrotechnists; and, therefore, signals for naval, military, telegraphic, or other purposes, may be made with the magnesium, or alloys.

As a modification of this improvement, asbestos, cotton, flax, or other textile substance, capable of absorbing any concentrated solution, or preparation, of the above-named metals, may be combined with magnesium wire or bands. The best preparations for this purpose are the chlorates, nitrates, and chlorides of the metals.



The next improvement consists in adapting to the break, or stopping mechanism *i*, of the clock movement a wedge *j*, which is introduced into the tube, containing the break lever i^1. By inserting this wedge *j*, above the break lever i^1, as indicated by dots in Fig. 1, the stop, or break *i*, will be kept out of action when the clockwork is required to be in motion. When the clockwork is to be stopped, the wedge *j*, is to be withdrawn, and the break *i*, will stop the movement.

Fig. 3 is a plan view, and Fig. 4 a side view of another mode of holding the stop lever down. In this instance the wedge is dispensed with, and the stop lever i^1 is held down by a stud at the end of the flat spring j^1. As the lamp is mounted on three legs, it can be placed on a table or stand, and allowed to remain in any given position without being held by the hand. The tubular wick, or wire holder *e*, is screwed into its place, as seen at e^1, Fig. 1; so that, should it become damaged, it may be unscrewed, and removed with facility, and another holder, screwed in its place. This tubular holder *e* should, by preference, be constructed of platinum, or some other metal which is difficult to melt, or the tube may be provided with a platinum nose; the object of this improvement being to prevent the tube from being fused by the heat of the burning wire. The vapours evolved by the combustion of the wire escape up the chimney *k*, in which an upward draught is produced, by means of a fan or ventilator *l*, Fig. 2, which is worked by clockwork, as shown. The reflector case is perforated with holes *m*, *m*, Fig. 1, for the admission of air to the combustion chamber, The air, as it is drawn in by the ventilator or fan *l*, will ascend the chimney *k*, and pass down the flue k^1 into a vessel *n*, containing an acid or other solution, capable of taking up and absorbing the metallic vapours.

The next improvement consists in combining sodium, potassium, or other alkaline metal with magnesium. This alloy will give a red, but strong, heat and light, and will greatly facilitate the ignition of the magnesium or other wire. To adapt this improvement, the alloy of sodium and magnesium is cut up into small pieces, and protected from the atmosphere, by being coated over with varnish, and then wrapped in tinfoil. One of these pieces is attached to the end of the magnesium wire by being squeezed on it, and when it is required to ignite the wire, this may be done at once by applying thereto a lighted match.

The patentees claim, "the general arrangement and construction of apparatus described for feeding forward magnesium or other wire, to be burned for lighting purposes."

* Extracted from *Newton's Journal of Arts.*

THE INVENTOR OF ELECTRO-PLATE.

George Richards Elkington was born on the 17th of October, 1801, at St. Paul's-square, Birmingham. He was the patentee of the electro-plating and gilding processes, which he introduced commercially in the year 1840, and so rapid was the application of the principle to the manufacture of all kinds of articles, that from the small beginning of perhaps a score of persons employed by Mr. Elkington in the first instance, the firm which he founded now employ upwards of 1,000 persons, and the trade has become one of the most important in his native town, where he may thus be said to have been the founder of an entirely new branch of industry, giving employment, directly and indirectly, throughout the United Kingdom to probably not less than 10,000 persons. His great enterprise and good taste have no doubt largely conduced to place the products of his works in the high estimation in which they are universally held. He was an extensive exhibitor at all the great international exhibitions, and never failed to carry off a large share of the medals and rewards that were obtainable. Though always desirous of encouraging native talent in all branches of his trades, he was still obliged to admit that in designing and modelling this country has still much to learn from the French, and he has, consequently, always employed both French and English artists in those departments. He was well known to be always ready to adopt any improvements in machinery—so much so, that any new methods of accomplishing any of his processes of manufacture were generally at once offered to him by the inventors, and his works at Birmingham now comprise all the leading improvements, and are among the standard attractions of his native town. He was also extensively engaged in copper smelting and coal mining operations in South Wales, employing several hundred workpeople, which businesses, as well as those carried on by him in Birmingham and London, in connexion with which he was more generally known, will now be continued by his sons.

His kindness of manner, just dealing, and unostentatious liberality were proverbial, and his death has been universally regretted. His death was caused by paralysis, and took place at his residence, Poolpark, Denbighshire, on the 22nd of September last. —*Journal of the Society of Arts.*

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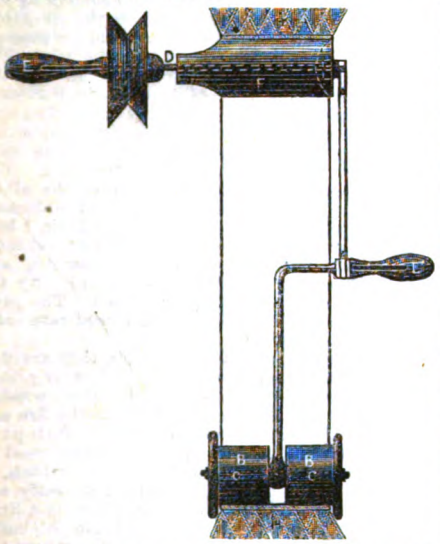
APPARATUS FOR BRUSHING HAIR.

This invention of Mr. Casimir Roques, Edinburgh, relates to certain improvements in the construction of brushes used for brushing the human or other hair, but is more particularly applicable to brushing long hair, such as that grown upon the heads of females. The apparatus consists of a rod or shaft upon which a pulley is rotated by the motion of a driving belt, the shaft or rod being furnished with handles, by which the operator holds the brushing apparatus against the head of the person or object to which it is applied. Upon the rod or shaft there is also fixed a frame of metal, at each end of which a roller is fixed; upon this frame the brush is stretched, and is caused to travel upon the rollers by means of a belt passing from a pulley (connected and driven by the driving pulley) on to one of the rollers which carry the brush. When stretched the brush is in the form of an oblong, with rounded ends, and in travelling one of its sides is applied to the head of the person or to any other object being brushed, so that, in contradistinction to circular brushes hitherto used, which tangle, twist, and break long hairs or filaments, the present construction results in a continuously travelling brush by which these difficulties are obviated, and hairs or filaments of any length can be easily and efficiently brushed. The brush itself consists of a strip of leather, in which the bristles or wires are fixed.



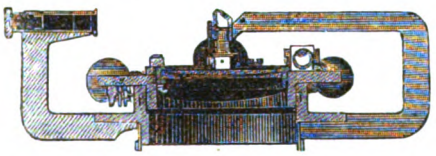
The engraving represents a front elevation, with the brush shown in section, of a brushing apparatus constructed in accordance with this invention. That portion marked A is a frame made of iron, or other suitable material. To one end of the frame, A, a round shaft or rod, C, is fixed in such a manner that it projects on both sides of the frame, thus forming two separate shafts, each of which receives a roller, B, revolving on it. At each side of these rollers is left a projecting edge to prevent the slipping off of the brush, which travels over them, as will hereafter be more distinctly described. Into the other end of the frame, A, the one end of a round shaft or rod, D, is screwed, or fixed in any other convenient way, or may be formed in one piece with the frame. The opposite end of the shaft or rod, D, has a handle, E, fixed to it, by which and by another handle, E', fixed at and to the frame, A, the apparatus can be held by the operator while in motion. Between the handle E and the frame A, a roller, F, made of wood, or other material, revolves on the round shaft or rod, D. It serves like the rollers, B, for the brush-belt to travel over, and to impart motion to the same, which is effected by a driving pulley, G, fixed firmly to the roller, F, or formed in one piece with this roller, and likewise revolving on the shaft or rod, D, so that, if the driving pulley is set in motion, it causes the roller, F, to move round in the same direction.

The brush, H, consists of a belt of leather, the ends of which are joined together, thus forming a regular driving belt. On the outside of this belt hairs or wires are fixed into the material of which the belt consists, in any convenient position. The inner side touches the rollers, B, working like one roller on the one end, and on a part of the roller, F, lying in a line with the former named rollers, B. If, therefore, the driving pulley is set in motion by means of a gearing moved by steam or other power, it causes the roller, F, as before mentioned, to revolve also, and this imparts motion to the brush-belt, H.

THE ROYAL OBSERVATORY AT GREENWICH.*

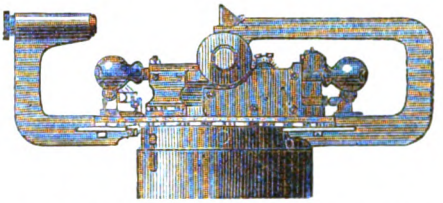
(*Concluded from page* 153.)

The reflex zenith tube, made on a peculiar principle, was designed by the Astronomer Royal, and constructed under his directions, by Mr. Simms, in the year 1851. The following is the principle of the instrument:—The star to be observed (γ Draconis) is so near to the zenith, that it may be seen with ease by an object-glass whose axis is immoveably fixed in a vertical position. When the star passes overhead, an image of it will be formed at the distance from the lens equalling its focal length. If, however, a trough of quicksilver be placed below the lens, at half the focal distance, the image of the star will be formed upon the object glass itself. Should the mercury be placed at a distance of more than half the focal length, the image will be formed below the object glass; if at less than the focal length, above it. Assuming the lens to be truly placed, and a star to pass over it exactly in the zenith, when the star crosses the vertical axis of the lens its image will be formed exactly at the centre of the object glass. Should the star not be exactly in the zenith, it will not pass over the true centre of the lens, consequently the image reflected from the mercury will be formed at the same distance on one side of the centre of the lens as it entered on the other, the point between the two spots being the true vertical axis of the lens, and the true zenith. The angle given is the basis on which the calculations of the zenith distance of the star are founded. To find the true vertical line with which to compare each observation, a micrometer is attached to its moveable cell, and the micrometer wire placed upon the image of the star; the object glass is then turned half way round, the micrometer wire is again placed upon the same image, and, wherever the centre of the object glass may be, the vertical line which gives the means of computing the angular zenith distance is exactly in the middle of the space over which it was necessary to shift the micrometer wire. A little consideration will show that it does not matter whether the object glass revolves round its own centre, or any other vertical line passing through it. It is necessary that the azimuthal movement, or the movement of the lens round its vertical axis, be an accurate rotation round one vertical line, consequently the object glass must be carefully mounted.



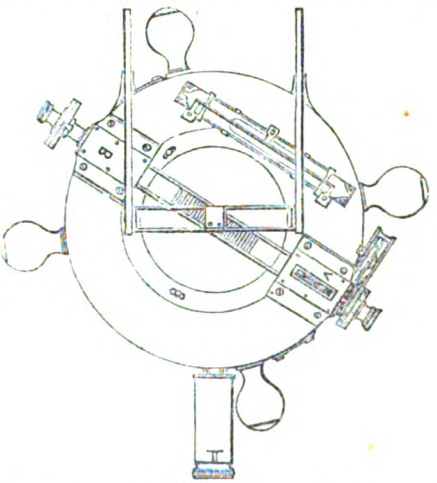
The above is a section of the object glass, and upper part of the reflex zenith tube, the tube itself, and the cup of mercury below being omitted. S is the eye-end sliding in a socket. It comprises the third and fourth lenses of the eye-piece, or field-glass and eye-glass. R is the bent arm carrying the eye-end of the eye-piece. I^{III} is the flange of the sliding tube. Its edge is graduated for azimuth, the readings proceeding to 360 deg. I^{IIII} is the highest part of the sliding tube in which the rotating apparatus is inserted. I is the sliding tube. D is the fixed tube of the instrument. N, N, the two bars carrying the diagonal reflector. O, the diagonal reflector, a prism of glass. The inclined face and the lower or horizontal face are plane, but the vertical face is convex, and thus discharges the office of the second lens (counting from the object glass towards the eye) in a four-glass eye piece. The star γ Draconis, which is to be observed with this instrument, is not in the zenith, but nearly 2 min. north of the zenith; consequently the reflector O and the lens below it are placed, not over the centre of the object glass, but as far south as to correspond with 2 min. nearly. Q is a pointer attached to the frame of O, which comes nearly in contact with the frame that carries the micrometer wires, and indicates to the observer whether it is wire 15 or wire 16 which is viewed by the eye-piece. M, arms firmly attached to the sliding tube I, and which carry the bars N. *h* four handles, to move the rotating apparatus; *g*, flange of rotating apparatus; *e*, apparatus for relieving friction of the rotating frame; *k*, the cell of the object-glass; g_1 the short tube of the rotating apparatus which turns within I^{IIII}; *l* the object-glass; this was formerly the object-glass of the 10ft. transit; its focal length is about 10ft. 8in., and its aperture 5in.; *s* the upper, and *p* the lower micrometer bars; *m* a spirit level.

The following is an elevation of the north side of the instrument:—



☞ The diagram at top of next column is a horizontal section of the upper part of the zenith tube, showing the rotating portions, though not in the position they occupy when in use.

The last refracting telescope at Greenwich, the one that yet remains to be described, is the great equatorial, the finest instrument of the kind in England. The telescope is used for viewing the planets, comets, and other heavenly bodies, whenever any interesting phenomena claim attention; it is, of course, *the* great object of attraction to visitors, yet it is little in request at the Observatory, where it is seldom used, and regarded somewhat as a magnificent philosophical toy. No observations involving calculations are ordinarily made by its aid, although in the great eclipse of the sun in 1860 it rendered most valuable assistance. The great object glass, which was made by Merz, a German, is 12¾ inches in diameter, and many castings and partly ground lenses were rejected by him, before the present one was passed. A very few specks in the shape of minute air bubbles are visible in it. The great difficulty in optical glass is that it must be first brought in the furnace to a state of perfect liquidity to expel the air bubbles, and that in cooling the large proportion of lead it contains is liable to separate into layers which have more density, and are less transparent than the rest of the glass. The Americans have a much finer object glass at Boston, of fifteen inches diameter, and twenty-five feet focal



length. The object glass of the Dorpat telescope, at Pulkova, is fifteen inches in diameter also. All the framework of the great equatorial telescope at Greenwich was made by Ransome and Sims, of Ipswich, and the eye-pieces, graduations, and circles, by Troughton and Simms, of the Strand, London.

Some of the foregoing details will prove the excessive care taken to test the accuracy of the line of reference, the flexure of tubes, the true position of the pivots, and all the parts liable to error, the concurrence of each and all of which has a tendency to introduce inaccuracies in the calculations, and errors in time. These points being all known and provided for, it remains to register the true time of the passage of a star as it is seen through the telescope to cross the micrometer wires. One hand of the observer rests upon the end of the telescope near the eye-piece, and all he has to do is to tap with his finger a small button beneath his hand every time the star passes a micrometer wire. The true instant of time of each tap is recorded as follows, by means of galvanic chronographic apparatus.

A large brass barrel, revolving in two minutes of sidereal time by means of clockwork, is covered

(* Extracted from the *Engineer*.)

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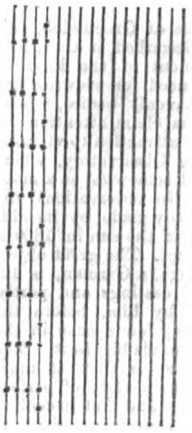
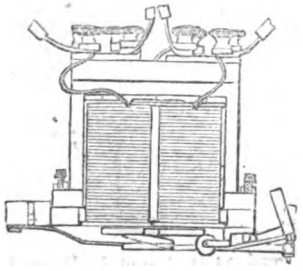
with a layer of woollen cloth. A sheet of paper is wetted, wrapped round the cloth, and its folding edges fixed by gum. This has to be ruled with one long line, in a fine spiral passing from end to end of the barrel, which to the eye appears to be numerous parallel lines passing all round the barrel, each of them only about one-tenth inch apart. A pricker is carried very slowly along the top of the barrel, and pricks a dot every second on the long spiral line on the barrel. It only makes fifty-nine pricks to the minute, leaving a blank at the sixtieth, which serves as a mark to distinguish each minute. Here then is a barrel, covered with a long spiral line, and a pricker marking the time on that line with chronometrical accuracy. But there is a second pricker, which only makes a mark when the observer of the passage of the star taps the button by the side of the eye-piece of the telescope, and these marks are pricked in the white space between the two lines, so are at once distinguishable from the marks of the seconds pricker, which always fall upon the lines. The accompanying cut shows the manner in which the barrel is ruled, and seconds dots marked on the spiral round at regular intervals, the sidereal time of each second thus marked being known. When, however, a star passes the field of the telescope, the dots from the second pricker fall at different intervals *between* the ruled lines (*vide* cut), so, by comparison with the regular rows of seconds dots, the time of the passage of a star is recorded to the fraction of a second, and thus Greenwich time is obtained. This is afterwards transmitted to Mr. Varley's chronograph in the International Telegraph Company's Offices near the Bank, and the chronograph sends it automatically to all parts of the United Kingdom, and in addition fires time guns in some of the northern towns. It sends Greenwich time direct every day to all the principal towns in Scotland, Ireland, Wales, and to a few on the Continent.



The prickers are moved by electricity. The circuit is completed through the electro-magnet of one of them by means of a toothed wheel on the transit clock, each tooth recording a second. The circuit through the other is completed by the observer every time he taps the button near the eye-piece.

The accompanying cut shows the arrangement of the prickers side by side, as they pass over the barrel, one of them being elevated and the other depressed. When the lines are to be ruled, a pen filled with ink



and water is substituted for the seconds pricker. The electrical circuit is broken, and the barrel directly connected with the heavy clock weight, which makes it spin round with great velocity, and a fine spiral line is marked on the paper. A feeble battery is used to do the regular work, having just sufficient power to bring down both the prickers, when they chance to fall at the same instant of time.

This refined piece of mechanism might naturally be supposed to complete the apparatus necessary to observe the passage of a star with accuracy, yet such is not the case In using all delicate instruments the operator himself becomes a part of the mechanism. A locomotive may be perfect in all its parts, yet its speed depends upon the will of the driver. The telegraph companies are obliged to consider the clerks as an essential part of the instruments, a part also commercially affecting the interests of the shareholders, and the speed of transmission of messages through a given wire. This, for instance, would be felt by the shareholders in a successful Atlantic Telegraph, did the clerks send but one word, value 20s., through the cable in the same time they should send two. It is the same at Greenwich, for unattainable perfection is required in the living part of the transit instrument.

A month or two ago we called attention in the *Engineer* to the curious fact that no two observers looking through a transit telescope see the same star pass the micrometer wires at exactly the same period of time. The French Astronomer Royal, in fact, has been recently making experiments to determine his own "personal error." It is just the same at Greenwich Observatory. The astronomers there rarely see the same star alike, one always sees it pass a fraction of a second before or after another, but this difference is nearly invariable. For instance, B, will always see it pass a little before A, and never a little after, except perhaps in case of illness, or other extreme disturbing cause. The more curious fact is, that there is no possibility of determining who is right or who is wrong, but the constant quantity of the variation, admits of a standard being chosen and considered as the right one, which it is for all practical purposes.

After a very long series of experiments the Astronomer Royal determined to accept Mr. Dunkin as the standard observer at Greenwich, and the following table shows the variation from the standard, or Mr. Dunkin, as deduced from those experiments. In the table (—) means "before," and (+) means "after."

Mr. Dunkin	D —	=	0·0	seconds
,, Stone	D — S	=	— 0·14	,,
,, Ellis	D — E	=	— 0·16	,,
,, Criswick	D — C	=	+ 0·16	,,
,, Lynn	D — L	=	+ 0·29	,,
,, Carpenter	D — J C	=	+ 0·07	,,
,, Dolman	D — M D	=	— 0·11	,,
,, Roberts	D — R	=	0·00	,,
,, Chappell	D — T C	=	— 0·12	,,
,, Nash	D — N	=	— 0·05	,,

It will be noticed, however, that out of all these observers, two, Messrs. Dunkin and Roberts, chance to read the passage of a star alike. The figures applied for the correction of the observations of each reader are styled in England his "personal equation," and in France his "personal error."

Beyond the regular work of the Observatory, and the new calculations as to the distance of the sun, from the earth, little has taken place there recently of unusual public interest. Biela's comet is expected, but has not yet been seen, and Faye's comet is fast disappearing, yet during its present visit has not been once sighted at Greenwich, from the unfavourable state of the weather. Both these comets are very small and faint, and little can be made of them without a powerful glass. The sun was hitherto supposed to be 95,000,000tof miles from the earth, but recent experiments at Greenwich, as communicated by Mr. Stone to the Astronomical Society, have proved the distance to be about 91,400,000. This was ascertained by careful observations of the planet Mars. The distance from the earth to Mars was not known, or from Mars to the sun, but the proportionate distance between the three bodies had been previously accurately ascertained. Mars gives the largest angle of any easily observable planet, and it was necessary to make the observations at a time when it was very near to the earth.

For many nights, when the weather was favourable, simultaneous observations of Mars were made at Greenwich, Pulkova in Russia, the Cape of Good Hope, and Williamstown in Australia. Mr. Stone put together the observations taken at Greenwich and the Cape of Good Hope, and Greenwich and Williamstown. Dr. Winnecke united those taken at Pulkova and those taken at the Cape. All the results taken at these different parts of the earth agreed very closely, and the sun has just been pronounced 3,600,000 miles nearer the earth than taught in the schoolbooks and primers of our younger days.

SOLDERING.

(*Concluded from page* 153.)

The copper tool, it should be understood, is applicable only to metals, as it requires such a degree of heat as will allow it to raise the temperature of the work to be soldered to the melting point of the solder; and the excess of heat thus required for *stout* metals is apt either to burn off the coating of solder, or to cause it to be absorbed into a superficial alloy. Thicker pieces of metal, which cannot be conveniently managed with the copper bolt, are first prepared by filing or turning, and each piece is then tinned by dipping, say for small pieces, into a ladle containing melted solder covered with powdered sal ammoniac. The flux meets the work before it is subjected to the heat, and the tinning is readily done. Larger pieces are dusted with sal ammoniac over the fire and the tin rubbed on to the surface—readily adhering if that surface be clean. The parts to be joined are then made a trifle hotter than for tinning, and placed in contact whilst the solder is quite fluid, a little additional being added. The two parts, where practicable, are then rubbed together to spread the solder evenly through the joint and cooled under slight pressure. Many workmen, as mathematical instrument makers, are very successful with the blow-pipe in soldering: practice here gives the necessary observation and facility. Gasfitters are very expert in joining tin and lead pipes with the blowpipes; they cut off the ends of the pipes with a saw and file the surfaces to meet in butt joints, in mitres, or in T-form joints as required. In confined places heat is applied by them from one side with the blow-pipe and rushes, a rich tin solder being employed with an oil-and-resin flux. Mr. Holtzapffel says—"An ingenious workman assured me that he had employed this mode for lead pipes measuring externally 1½ inch in diameter and situated in angles by placing pieces of slate against the floor and perpendicular partition to defend them from the flame, the action of which was assisted by two pieces of charcoal inserted in the corners. And also, that as a trial of skill, he had made fifteen joints in ¾ inch tin pipe, five of each kind—plain, mitre, and T-form—including the preparations, in twenty-five minutes!" The pewterers employ what may be termed the hot-air blast, as shown in Fig. 6 in our last issue: the names for this apparatus are peculiar—*a*, in that figure (which see) being called a "hod," and *b* the "gentleman." The first is a common cast-iron pot with a close cover containing live charcoal; two nozzles lead one into the other from it to allow the passage of a stream of air through the pipe *c*, from bellows worked by the foot. The ware to be operated on is placed on the "gentleman"—a revolving pedestal, capable of adjustment to any height by means of a side screw. The operator dips the strip of solder in a little pot of oil, and applies the solder to the joint with one hand whilst with the other he revolves the work. The pewters bear nearly the proportion of the alloys Nos. 8 to 12 (see tables): for the less fusible containing most tin, the solder No. 8, or 2 tin 1 lead is used; for the more fusible, containing most lead, the bismuth solders, 2 tin 1 lead 1 bismuth, and others of varying fusibility are employed. By the table alloys can be exactly proportioned. The pewterer's flux is Gallipoli oil; it is a second-rate olive oil, thick and green.

In coating copper and brass vessels, they are first pickled with sulphuric acid—1 acid 3 water; they are then scrubbed with sand and water, washed clean and dried; they are next taken to the fire and heated, a bit of tin thrown in together with powdered sal ammoniac, a wiper of tow being used to sweep the tin over the heated surface, to which, if clean and sufficient flux dropped in, it really adheres. What of the tin is in surplusage—for a little goes a very long way—is wiped out into the ladle. If any "stubborn" parts are met with, where the tin won't "take," it is usual to take a piece of sal ammoniac fastened in a tongs and rub in the tin well and perseveringly. Iron presents more difficulty; the affinity of tin being less strong for it than for copper. The treatment, however, is the same. Old pots are well scraped with a sharp tool to get a fresh surface, and the pot heated to drive off any grease that will not yield to muriatic acid. Often the acid has to be boiled in the pot before the grease can be "spirited away." We have seen a small globule of mercury go an extraordinary long way in tinning a pot and bringing it out with a lustre equal to silver. By the way this is a capital plan in tinning jelly moulds of intricate pattern, the mouth being kept from over the work as much as possible whilst this volatile "flux" is being used. But the mercury should not be encouraged. It were better to purchase a new pot instead, there may be a positive gain in so doing.

In soldering "over edge" when the tin is brought down an inch or two over the outside, just paint *up* to the line from the bottom with whiting, that part won't "take" and the line assists the operator in his job.

Burning together differs from ordinary soldering, in so far as the metal used is the same as that of the pieces to be joined, and in general no fluxes are used. The method is an important one, as when cleanly done the works are very strong. Pewter is sometimes burned together at the external angles of works, so that no difference of colour may occur: the one edge is allowed to stand a little above the other, a strip of the same pewter is laid in the angle, and the whole melted together with a large copper bolt heated almost to redness, the surplus metal is filed off, leaving a good angle without any visible joint.

Brass is likewise burned together; for instance, the rims of large mural circles for observatories are

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sometimes cast in half-a-dozen segments and attached by burning. The ends of the segments are filed clean, two pieces are fixed vertically in a sand mould in their relative positions, a shallow space is left around the joint, and the entire charge of a crucible is poured on the joint to heat it to the melting point. The metal overflows the hole and runs into a prepared sand-pit; but the last quantity of metal that remains solidifies with the ends of the segments and forms a perfect joint.

This week we have to notice the airo-hydrogen blow-pipe invented by the Count de Richemont. It is in a great measure converting the oxy-hydrogen blow-pipe invented by Dr. Hare to the service of the workshop, and it is done with simplicity and safety. The elastic tube *h* supplies the hydrogen from the generator, and the pipe *a* supplies atmospheric air from a small pair of double bellows *b*, worked by the foot of the operator and compressed by the constantly applied weight *w*; the two pipes meet at the arch and proceed through the third pipe *c* to the small jet *f*, from whence proceeds the flame. All the connections are by elastic tubes which allow perfect freedom of motion. In soldering by the autogenous process the works are prepared as usual, the hydrogen is ignited and the size of the flame proportioned by the stop-cock *h*; the air is then admitted through *a* until the flame assumes a point, when the work is joined after the method of blow-pipe soldering, except that no flux is used and a strip of lead is used instead of solder. The best application of this method is to plumbers' work. The lead consumed in making the joints is nothing near that of the ordinary solder, which is more expensive, owing to the tin it contains.

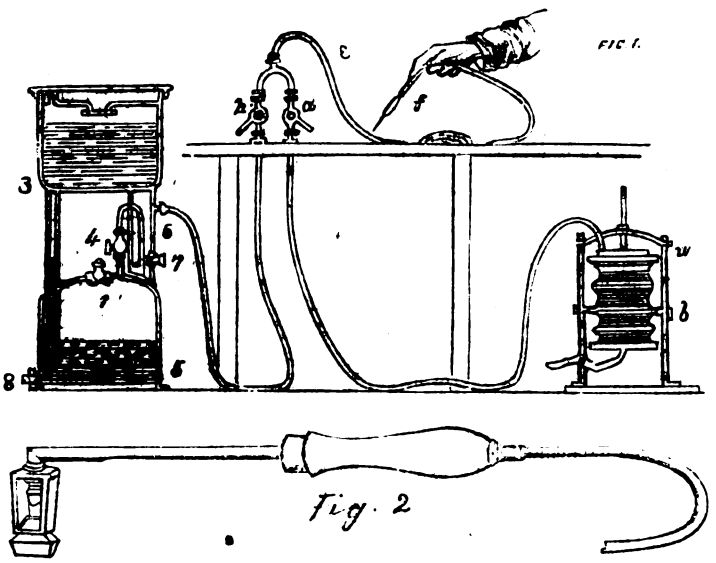


Fig. 2

Lead is used in uniting zinc to zinc, and is also used in soldering the brass nozzles and cocks to the vessels of lead and of copper coated with lead used as generators. Another practical application of the gas flame is, for keeping the copper soldering tool Fig 2 at one temperature, which is done by leading the mixed gases through a tube in the handle, so that the flame plays on the back of the bit. This seems adapted to tinplate and zinc work, and as the common street gas may be used, the gas generator to be described may be dispensed with. The generator, Fig. 1, somewhat resembles Pepys' gasometer. When first charged the stopper 1 is unscrewed and the lower chamber nearly filled with curling shreds of sheet zinc, when the stopper is replaced. The cover is now removed, and a plug with a long wire is inserted from the top into the hole near 3, the upper chamber is next filled with dilute sulphuric acid (1 acid 6 water) until it is just seen through the central hole to rise above the plate immediately beneath it. This measures the quantity of liquid required to charge the vessel without risk of overflow. The plug is now withdrawn from 3, and the cocks 4 and *h* being opened, the air escapes from the lower vessel by the pressure of the column of water which enters beneath the perforated bottom 5, upon which the zinc rests. The cocks 4 and *h* are now closed, and by the decomposition of the water hydrogen is generated, which occupies the upper part of the lower chamber and drives the dilute acid upwards through aperture 3, so as to place things as in the engraving, which represents the generator about two-thirds filled with gas. The gas issues through the pipe *h*, when both cocks are opened, but it has to proceed through a safety box 6, in which the syphon tube dips two or three inches into a little plain water introduced at the lateral pressure 7; by this precaution the contents of the gasometer cannot be ignited, as, should the flame return through the pipe *h*, it would be intercepted by the water in the safety box. The liquid becomes converted into sulphate of zinc after two or three days' use, and is withdrawn at 8; the vessel is then re-filled with dilute acid, but the zinc lasts a long time. We shall conclude this section in our next.

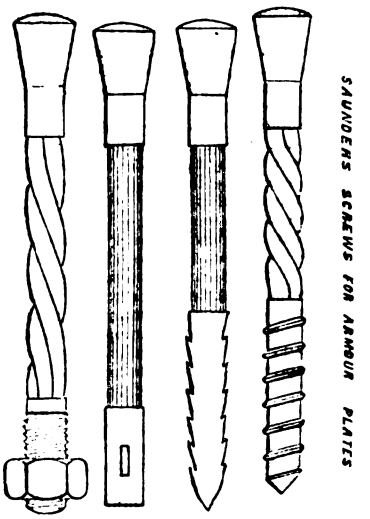
(To be continued.)

JORDAN'S PATENT FOR COMPOSITE IRON AND WOOD SHIPS.

JORDAN *v.* MOORE.—During the past week the above case of infringement of this patent was tried in the Court of Common Pleas, before Mr. Justice Byles and a special jury (of nine by consent). The invention in question is one of very great importance, and consists in making a complete skeleton or frame of the ship in iron, to which the external and internal planking (the latter technically called the "ceiling") can be effectually secured, in order to complete the perfect ship or vessel. The details of Mr. Jordan's invention, as presented in his drawings and specification, are that he uses a keel and keelson of iron (though there may be a partial substitution of wood for the iron), from which the iron ribs rise; the keelson also rising at the stem and stern, so as to form what may be termed an inverted arch (inside the vessel), for the purpose of strengthening the structure. The ribs are connected together by means of iron bands or stringers passing *directly* in the longitudinal direction from stem to stern, the ribs having also diagonal ties of iron, and iron ties which pass from side to side of the vessel, to secure the same transversely. It was admitted by all parties that a ship constructed as described would be a strong, seaworthy vessel; but contended by the defendant that the plaintiff's patent (a prolongation), was not valid and effectual in law, because he had in his specification claimed too much, or what was not new. He had stated in that document that his claim was in effect for a complete skeleton or frame of iron (*i. e.*, a complete skeleton or frame, whether its constituent details be the same as those before enumerated or otherwise), and was not limited to the particular details he had described with reference to the drawings accompanying his specification; further, that he had made a distinct and separate claim for the mode of securing the butt-joints of several parts in the structure, which butt-joints consisted simply in placing over the line of junction, on the inner side, a piece of metal, with a waterproof packing piece secured to each of the two parts, joined together, and that this was a notoriously well-known method of securing butt-joints, as practised by carpenters, shipbuilders, and other mechanics. In support of the defendant's objections he also put in evidence several specifications of old patents (anterior to the year 1849, the date of the plaintiff's original patent), amongst others, one by Mr. Watts, in the year 1814, in which the ribs were connected together and to the keel by what, although not the same in *form*, was in effect identical with the plaintiff's stringers; also a patent of Mr. Ditchburn's, dated 1841, in which truss-plates, so-called, were adopted, but which were substantially the same as the plaintiff's diagonal tie system.—After occupying the Court nearly three days, the case was decided in favour of the plaintiff.—The verdict being for 40s. damages.

IMPROVEMENTS IN ARMOUR PLATES TO VESSELS.

This, the invention of Mr. Edward Saunders, of Bridge-street, Westminster, relates to the use of screw and other bolts, spikes, and rivets of novel construction for general fastening purposes, and amongst others the fastening or securing of iron and armour plates to marine and other batteries, ships of war, and other vessels, in lieu of the solid metal bolts, spikes, and rivets hitherto used. When solid bolts are used in affixing plates of iron to the above structures, they are liable to be either driven through or shattered or broken by the impact of heavy projectiles; this liability increases as the size and consequent rigidity of the solid bolts is augmented, as in the case of thick and heavy plates, in fastening which it becomes necessary to increase the size of the bolts, in order that they may support as well as fasten the same to the under work. To remedy the above defect in these fastenings is the object of this invention, which is accomplished by making the body, shank, or centre part of the bolt, spike, or rivet of a number of wires, rods, or strands twisted, or so placed together that in transverse section they shall possess the required tensile strength, and at the same time a considerable degree of elasticity, and to make the heads and ends or points solid, by beating and welding, hammering, or compressing the same.



The figures illustrate several forms of the improved bolts, spikes, and rivets, in making which a good piece of wire rope is employed, the same being cut to the required length, and the heads and points or ends are forged solid. Instead of welding or forging the wires to form the head of the bolt, they may, in some cases, be spread out, and wedges driven in to spread them from the outside, so as to cause the whole mass to conform to the tapering hole in the plate, and then to cover it, if necessary, by any suitable kind of metallic or other packing.

The patentee claims, "the method of constructing a screw bolt, blunt bolt, spike, or rivet of wire or rods of any shape, in such manner that with a solid end, with or without thread, and solid or proper head, the shank or intermediate portion shall retain a certain degree of elasticity not possessed by any ordinary solid rivet, spike, screw, or bolt."

As an instance of the value of labour it has been shown by Mr. Babbage that the pendulum spring of a watch, which governs the vibrations of the balance, costs at the retail price twopence, and weighs the 15th of a grain; while the retail price of a pound of the best iron is only twopence. Out of that weight of iron fifty thousand such springs are made.

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REVIEWS.

Tables for Workmen's Wages. By H. Laxton, C.E. London: the Author's, 34, Arundel-street, Strand, W.C.

We have been favoured with the two editions of this handy little work,—the "red book" for employers, and the handy folding pocket companion for the workman. The tables of which the book consists contain over 7,000 calculations, carefully corrected and simply arranged. Table No. 1 shows at any price per day the amount of wages per week, month, year, &c.; No. 2, shows at any price per year the amount of wages or rent per quarter, month, day, &c. Table 3, shows at any price per hour the amount of wages for any number of hours; and No 4 gives at any price per day the amount of wages for any number of days, quarters, or hours. The whole affair is simply a very clear, well printed, and easily understandable ready-reckoner, which may well be recommended to both master and men.

A Treatise on Smoky Chimneys, their Cure and Prevention. By F. Edwards, jun. Third Edition, London: Hardwicke, 192, Piccadilly.

The days of smoky chimneys are not by any means gone by, though they ought to be; nor will they, so long as speculative builders run up cardboard houses and people are found to inhabit and suffer in them. Mr. Edwards' treatise is exhaustive and clever; it deals with the whole subject of our domestic fireplaces in a concise and understandable way, and if it were generally read could not fail to bring about some amendment in our present evil and wasteful course. It should be in the hands of all who can in any way influence the construction of fireplaces and chimneys. Our author instances fifteen causes for the non-efficiency of our chimneys, which we append, together with the approved remedies.

FIRST DIVISION.

Chimneys that smoke in consequence of a descending current existing, or being produced in the chimney, irrespective of wind.

Cause 1.—From a fire-place being too open. *Remedy:* To contract the size of the fire-place, or use a contracted grate.

Cause 2.—From the doors and windows of a room being fitted too closely. *Remedy:* To supply air by means of doors and windows, or to give a special supply near to the fire.

Cause 3.—From fires being lighted in two or three adjoining rooms, which are inadequately supplied with the air required by the grates in use. *Remedy:* To contract the opening into the chimney. To give an additional supply of air. To use grates that will not allow much air to ascend the chimneys.

Cause 4.—From a chimney being very short. *Remedy:* To use a contracted grate with a blower. To reduce the height of the fire-place and the size of the chimney. To lengthen the chimney. To reduce the opening into the chimney at bottom and at top.

Cause 5.—From a chimney being situated in an external wall, and not being sufficiently protected against the action of the external air. *Remedy:* To improve the construction of the chimney. To use a very contracted grate. To reduce the opening into the chimney at bottom and at top.

Cause 6.—From a chimney being exposed on two or three sides to the action of air; the exposed brickwork not being sufficiently thick. *Remedy:* To improve the construction of the chimney.

Cause 7.—From a low chimney being in connection with a room adjoining a house or building in which the air becomes rarefied. *Remedy:* To supply the house and room liberally with air. To fit tightly the door of communication. or use a double door. To use a contracted grate. To heighten the chimney. To reduce the size of the chimney.

Cause 8.—From a down current in a fire-place bringing smoke from an adjoining chimney. *Remedy:* To supply the room properly with air. To use a carefully fitted regulator to the chimney.

SECOND DIVISION.

Chimneys that smoke in consequence of a descent of wind.

Cause 9.—From the top of a chimney being situated below a pitched roof. *Remedy:* To heighten the chimney that its top may be above the source of obstruction.

Cause 10.—From the top of a chimney being situated near to a tower, or similar source of obstruction to the wind. *Remedy:* To heighten the chimney. To use a simple protection, as fig. 12.

Cause 11.—From a short chimney being enclosed on three or four sides by high contiguous buildings. *Remedy:* To heighten the chimney. To put a simple protection at top. To use the most contracted grate, and supply air below in moderate abundance. To reduce the size of the chimney or the extremities.

Cause 12.—From rooms with short chimneys being situated between the main body of a building and a contiguous eminence. *Remedy:* To build the chimneys to the extreme height of the main building. To use the remedies indicated for Cause 4. To use a simple protection, as fig 12

Cause 13.—From chimneys of one house being lower than those of one adjoining. *Remedy:* To heighten the chimneys. To put a protecting roof as fig. 13 or 22.

THIRD DIVISION.

Chimneys that smoke in consequence of their being too small.

Cause 14.—From a chimney being too small for the fire-grate used. *Remedy:* To use a grate that will allow a minimum quantity of air to ascend the chimney. To re-construct the chimney. To use a stove.

Cause 15.—From two fire-places being used to one chimney. *Remedy:* To use well-contracted grates, with carefully fitted regulators. To supply rooms sufficiently with air.

Most heartily do we recommend the work to those of our readers who feel interested in fireside comfort.

The appended lithographic plates are good, and well supplement the simply written introductory and explanatory matter.

TESTING NITRATE OF SILVER.

BY PROF. TOWLER.*

The profit on nitrate of silver is not great, because the original substance from which it is manufactured—the base of the salt—is, in and of itself, a dear article. The same may be said of the terchloride of gold. On some articles apothecaries and druggists can put on a profit of two or three hundred per cent. without exciting a murmur against their exorbitant charges, because these articles consist of cheap materials to begin with, and may in appearance be sold cheap even when burdened with the immense per centage. Thus you may buy, and probably have bought, an ounce of sulphuric acid, for which with the vial probably you paid a quarter of a dollar; this price does not appear particularly out of the way, and yet the profit is immense! We do not know the exact quotation of the price of sulphuric acid at the present moment; the last we bought cost us in the carboy, if we recollect right, about two cents a pound, or one eighth of a cent per ounce—the vial is worth two cents—hence the profit will be a little more than a thousand per cent. A handsome profit!

It is impossible to exact the same grade of profits on the two salts just mentioned, as the reader can easily conceive But because this is impossible, and the craving after unjust profits uncomfortably prevails amongst our very religious and moral people, this craving must be satisfied either by hook or by crook. They take the former experiment—they use the hook—and hook on to the real nitrate of silver and the real terchloride of gold some uncostly substitute, as an alkaline, &c., nitrate or carbonate, whereby the prices of the to expensive salts may remain the same, whilst the profits gradually increase, as the consciences of the manufacturer gradually expand, like the inflated maw of a turkey.

It becomes our duty therefore, to instruct our readers how to test for the impurities in the adulterated articles.

Crystalline Form of Nitrate of Silver.

It is by far the best to buy nitrate of silver in crystals, and not as lunar caustic or as an amorphous powder. The form of the crystal, when pure, is tubular; so that if octohedral or prismatic crystals are descried amidst these flat tubules, you may feel assured there has been an adulteration. If, on the contrary, the crystals are uniformly of a tubular shape, it is almost equally certain the nitrate of silver is pure.

Where there is any doubt, proceed as now directed.

Testing for Impurities by Chemical Reagents.

Weigh out ten grains of the crystals, and dissolve them in distilled water; now add pure hydrochloric acid to the solution, drop by drop as long as there is a precipitate of the white chloride. Perform this experiment in the dark room.

Let the precipitate settle; and then add another drop of the hydrochloric acid in order to see whether all the chloride has been precipitated. If this be the case, separate the chloride by filtration, and wash the precipitate in several drachms of pure water, which is mixed with the first filtrate: that is, keep the liquids together.

The chloride may be that of lead or silver, it might also be that of mercury under certain circumstances, but it is not to be expected here.

Supposing that lead is present with the silver, we must now separate the chloride of the former from that of the latter metal by means of ammonia, which will dissolve the chloride of silver, and leave the chloride of lead. If all the chloride is dissolved, we conclude that a salt of lead was not present in the nitrate of silver: and the contrary, if a portion was undissolved.

In the liquid, other metals, besides those of the alkali might be present; but it is not very probable. In order to be sure of this fact, the solution is first boiled for some time and then a current of hydrosulphuric acid is passed through the solution, when cool, for a short time; the solution is again boiled and set aside to cool, &c., for an hour or more. Or a few drops of sulphide of ammonia may be added to the solution instead of passing a current of hydrosulphuric acid through it; the solution is then boiled as before, until all smell of ammonia and hydrosulphuric acid has disappeared.

If there is merely a *trace* of a black precipitate, it is evident that several salts (nitrates that might be there) are absent. A copious black precipitate would indicate adulteration with either one or several metallic salts, not one of which, however, is likely to be the salt with which the adulteration might be successfully made.

Filter the solution and then evaporate it to dryness.

A white sediment (having previously removed all excess of hydrochloric acid by boiling) will indicate the presence of the nitrate of one or more of the alkalies or alkaline earths.

It would probably be the safer plan to evaperate the original solution at once to dryness, and then, if there is a sediment, to conclude at once that there is adulteration with the nitrates of one or more of the metals. The sediment is then dissolved and proceeded with, as above marked out, with hydrosulphuric acid, &c.

By proceeding in this way there is no risk of forming the chloride of ammonium, in case the sulphide of ammonium had been the re-agent used.

As the object of the operator is simply to ascertain whether the nitrate is pure or adulterated, it is not necessary to point out by what means the analysis may be completed so as to indicate the precise metal in the adulteration where it exists. Such an analysis would be long and without any special aim for the practical photographer.

*From *Humphrey's Journal*.

PATENT LIST.

(*From the Commissioners of Patents' Journal.*)

LIST OF SPECIFICATIONS, &C. PUBLISHED DURING THE WEEK ENDING 16TH DECEMBER, 1865.

122. Capillary hydrometer, R. A. Brooman—4d.
233. Sewing machines, A. C. F. Derocquigny and D. Gance—1s.
212. Thread for weaving and other purposes, R. A. Brooman—4d.
243. Steam boilers and furnaces, J. Twibill—1s. 10d.
244. Treating and applying tar oils, J. H. Johnson—4d.
245. Applying tar oils in manufacturing paint, A. H. Brandon—4d.
246. Obtaining sugar from starch, G. Haseltine—4d.
247. Breech-loading fire-arms, S. Trulock, R. Trulock, and W. Trulock—1s.
248. Cotton gins, B. Dobson and W. Slater—4d.
249. Filtering apparatus, W. Bury—1s. 6d.
250. Rectifying alcohol, W. E. Newton—10d.
251. Washing wool and other fibrous materials, J. Petrie, jun.—4d.
252. Mortar and other mills, J. Raines—10d.
253. Breech-loading fire-arms and cartridges, W. Clark—1s. 10d.
254. Cartridge boxes, E. Blakeslee—1s.
255. Drying wool and other fibrous substances, E. T. Hughes—10d.
256. Lantern for burning hydro-carbon oils, A. S. Macrae—4d.
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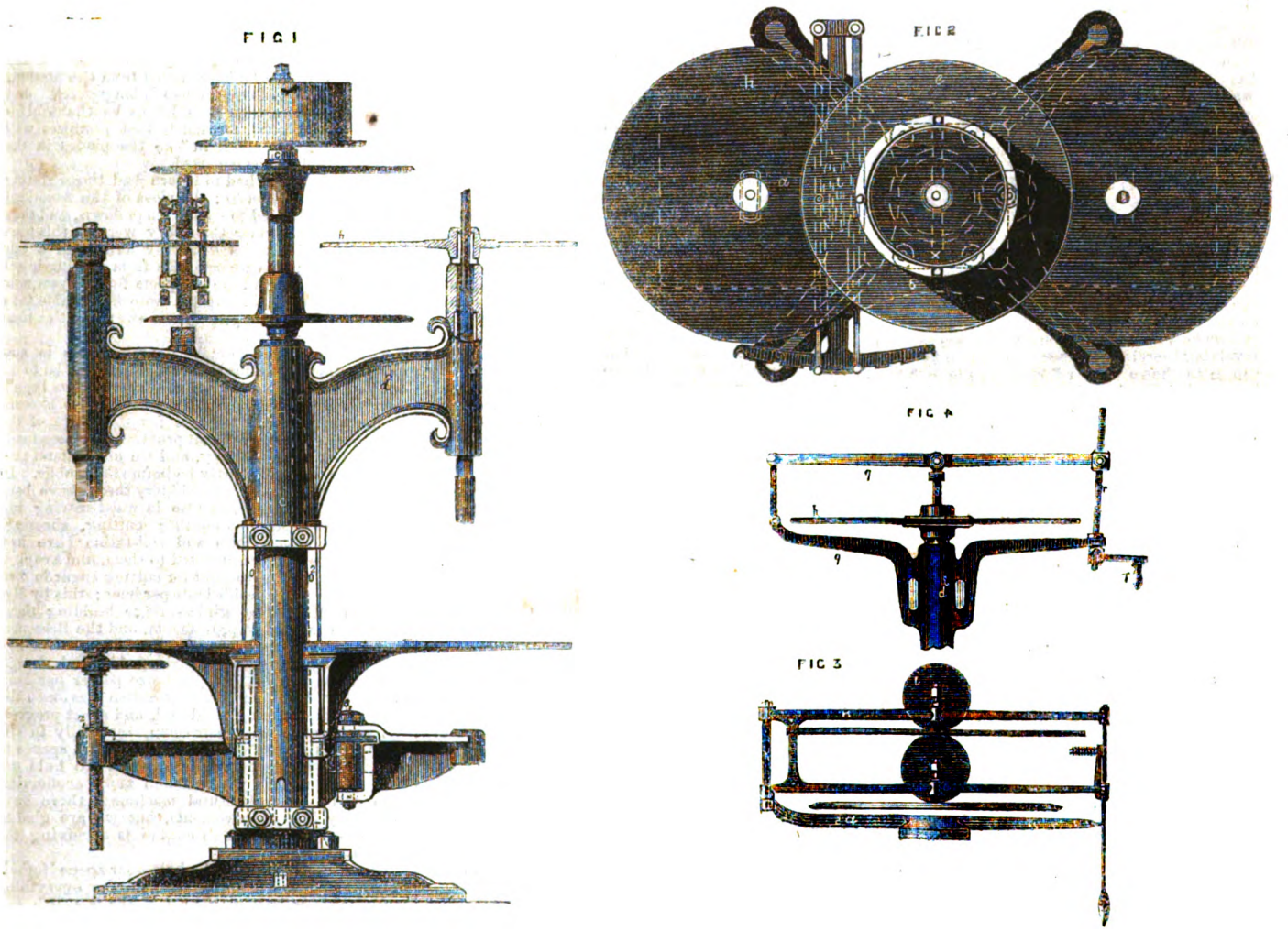

OBTAINING VARIABLE SPEED IN MACHINE TOOLS.

A PATENT has recently been taken out by Mr. John Combe, of Leeds, an engineer, for the invention of improvements in the action and management of drilling machines, turning lathes, and other machine tools, in which a variable speed is required, and which we have fully illustrated. The subject, our practical readers are well aware, possesses considerable interest; and we leave it for their consideration without any remarks of our own further than those necessary in explanation of the patent.

Figure 1 is a front view, partly in section, and *figure 2* a plan, with some of the parts removed, of a drilling machine arranged according to this invention; figures 3 and 4 are side views of some of the parts.

a is an upright hollow pillar bolted to a foundation plate *b*, having four feet b^1, projecting diagonally to give stability to the upright pillar. In the centre of the plate *b* is fixed a step b^2, to receive the pivot end of an upright shaft *c* passing down through the pillar *a*, capable of revolving freely in a socket a^1 at the top of the pillar *a*. Immediately above the socket a^1 on the upright shaft *c* is keyed fast a horizontal disc *d*, the upper surface of which is turned true and level; above this disc *d*, another disc *e*, is also keyed fast on the upright shaft *c*; the disc *e* is turned on its lower surface so tha tthe two surfaces of the disc *d* and *e* facing each other revolve in perfect parallel planes. The upper portion of the upright shaft *c* has a screw thread cut thereon, and is provided with a nut c^1, by which the two discs *d* and *e* can be brought into closer proximity to each other as required; above this nut c^1, on the shaft *c*, are placed the usual fast and loose pulleys *f*, by which motion is communicated from the driving strap to the machine. The shaft *c* is capable of being slightly raised or lowered by turning the screws *x*, and thereby raising or lowering the bar x^1, on which the bearing b^2 rests. A projecting bracket a^2 is cast on the upright pillar *a*; this bracket a^2 has a socket a^3 cast thereon, which is bored out in a direction parallel to the axis of the upright shaft *c*; through this socket a^3 the drill spindle *g* is capable of revolving freely, being retained therein by two collars g^1, which fit against the upper and lower ends of the socket a_3. On the upper end of the drill spindle *g* is keyed a horizontal disc *h*, which is turned true and level on both sides and is placed between the two discs *d*, *e*, carried by the upright shaft *c*. The three discs *d*, *e*, and *h* are of such diameters respectively that their circumferences intersect one another to about one-third of their diameter. A pair of friction rollers *i* with solid leather surfaces are suspended on rods or bars *k* forming a kind of parallel motion working on two studs k^1, carried by the projecting arm a^4 on the bracket a^2; these rollers *i* are so placed respectively between the three discs *d*, *e* and *h* that the friction of the discs *d*, *e*, carried by the driving shaft *c* transmits motion in an opposite direction to the intermediate disc *h* carried by the drill spindle. The parallel motion which carries the friction rollers *i* is so arranged that the rollers *i* are capable of being traversed sideways to and fro between the axes of the driving shaft *c* and the drill spindle *g*, so that the nearer the friction rollers *i* are brought to the driving shaft *c* the slower will be the speed of the drill spindle *g*.

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and *vice versa*; the friction rollers *i* are capable of being fixed in any required position between the driving shaft *c* and the drill spindle *g*. On the lower part of the upright pillar *a* a bracket *l* is cast carrying a short socket or boss l^1, the axis of which is in a line with the axis of the drill spindle *g*. This socket or boss l^1 is bored out to receive a brass nut l^2 through which an upright screw *m* is passed, on which the table *n* which carries the article to be drilled rests; by means of the screw *m* the table *n* is raised and lowered as required. The table *n* is provided with four sockets which slide freely on two upright parallel bars *o*, so as to cause the table *n* to rise and fall in a vertical direction when acted upon by the screw *m*.

In order to secure a perfect balance, as well as economy in the construction of these machines, they are made double by casting on the pillar two sets of brackets on opposite sides carrying two tables and drill spindles, to which motion is given by one pair of discs *d*, *e*, and one upright shaft *c*. Some of the parts are shown repeated on each side of the machine, marked with similar letters of reference. When it is required to drill articles of greater length than could be accommodated on the tables *n* or n^*, the table n^* and the bracket l^* are turned out of the way, and rest the article to be drilled on the ground. For this purpose the rod o^1 is removed from the machine and the table n^* is turned upon the rod o^2 to one side, whilst the bracket l^* is turned on the pin l^3 out of the way when set at liberty by removing the set screw l^4. That the drill may be capable of approaching to and receding from its work, the upper part of the drill spindle g^* is formed with flat sides passing through a socket g^{**}, so that the drill spindle is capable of rising and falling through the socket g^{**}, and yet controlled to rotate therewith; on the socket g^{**} is fixed the disc *h* as shown; the upper end of the drill spindle g^* is extended through the socket g^{**}, and its upper end is formed to receive a pin g^2, which is capable of revolving therein, but is secured thereto by a screw cap g^3 as shown. By reference to Figure 4 it will be seen that the pin g^2 is at its upper end pin-jointed to the arm *p*, which is at one end pin-jointed to a link p^1 connected to the bracket *q* as shown, whilst the other end is provided with a nut capable of turning therein, through which a screw *r* passes; the lower end of this screw is provided with a handle r^1, by turning which the drill spindle g^* is raised and lowered as required. In applying the differential motion to turning lathes, the intermediate disc *h* is placed on the back end of the spindle of the fixed head, and to overhang the bearing, so that the circumference of the disc *h* may extend below the level of the gauntry. Arms projecting from the checks of the fixed heads carry bushes in which revolves a shaft *c*, carrying the belt pulley and the two driving discs *d*, *e*, for each fixed head, the studs carrying the parallel motion for traversing the friction rollers being fixed to brackets below and at the back of the gauntry. In a similar manner would a like motion be applied to other machine tools requiring such motion: and the inventor is of opinion that a competent workman will readily make the modifications necessary in adapting it to other machine tools.

THE Cardiganshire mines yielded, in the time of Charles I., 80 ounces of silver in every ton of lead, and part of the king's army was paid with this silver, which was minted at Shrewsbury.

GLASGOW INDUSTRIAL EXHIBITION.—Last Tuesday morning this exhibition was formally opened by the Duke of Argyll, in presence of a large assemblage. In the evening, a crowded meeting was held in the City Hall, at which the Duke of Argyll delivered the inaugural address. He took for his subject, "The agencies which have been and are brought to bear on the condition of labour in this country," and spoke at great length on the agencies of legislation, of voluntary combination among the working classes, of municipal government, and individual thought and action.

ROTATING BELLS.—Mr. Harrison, of the American Bell Company, has devised a means for preventing the fracture of bells, arising from the continuous pounding of the tongue in one place. For this purpose the bell is hung loosely upon a round bolt, which is suspended by a spur wheel made fast to the bell. This wheel communicates by a simple train of gearing to a lever on one side, which is actuated by a cam as the bell swings, and which turns the gearing by a pall and ratchet wheel, so that at each stroke of the tongue the blow is given on a fresh part of the bell. It is asserted that the imparting of a very slow rotation to bells, as above described, prolongs their durability indefinitely.—*Scientific American.*

TO ADVERTISERS.

As the ENGLISH MECHANIC addresses itself to the largest and most intelligent portion of the community, and is the only Paper of the kind established, it offers unusual advantages as an advertising medium.

SCALE FOR ADVERTISEMENTS:

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Five Lines	0	3	0
Every additional Line (Nine Words) ...	0	0	6
Whole Page	8	8	0
Half Page	4	4	0
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Advertisements to be sent not later than Friday. Letters to the Editor to be forwarded to 75, Fleet-Street.

The English Mechanic.

FRIDAY, JANUARY 5TH, 1866.

IMPORTANT TO THE READER.

IT has been represented to us from time to time, by various correspondents, that the pages of the ENGLISH MECHANIC were over crowed with advertisements and the general contents frequently too densely packed together; the paper on which the journal has been printed scarcely substantial and high-class enough for a work to be placed in the home library as an authority of frequent reference for many years to come; and generally that an article much superior might be given. All such complaints or suggestions—for they have come to us more as suggestions than complaints—have frequently been taken into deep and earnest consideration, and we have at length determined upon adopting at least such as shall do away at once with the necessity for complaint concerning the appearance of our journal; and, to achieve this desirable end, we need scarcely add, we require the co-operation of our readers. And thus, while we announce that the next number of this journal will be increased in size, and the MIRROR OF SCIENCE incorporated with it; that the work will be printed on a superior paper, with a clearer type and contain many more and varied articles on scientific matters,—we have to state that the price must be raised to TWOPENCE.

The cost of all articles worth having is on the increase—labour has advanced, and is advancing in value, while the hours for labouring are being reduced. We have consistently and warmly advocated the attainment of these blessings; and the fact of advances having taken place entails on us the necessity of raising *our* prices. We desire as much as other folks to live by our labour, and we can do this only by adopting the course above indicated. It is utterly impossible for a class paper as ours is—to be the organ of the Mechanic, and scientific student and be really acceptable—to pay its way and return a fair percentage on the necessarily heavy outlay connected with it, at the present very low figure. In every possible way have we tried to work it, but have been forced unwillingly to the conclusion that twopence is the lowest figure at which we can henceforward publish THE ENGLISH MECHANIC and *Mirror of Science* with the various improvements in size and appearance above indicated.

Here it may not be uninteresting to remark that the increased price has been often forced upon our attention by correspondents so far back as eight months ago; but as we had started at a penny—the popular price of the day—we could not think of agreeing to the suggestion of increased charge until every possible means of obtaining a return for the capital expended had been tried. It does not come with a very good grace from those who advocate increase of wages and reduction in working hours to beat down the prices of their own workpeople: we do not care to do this, and feel certain the readers of the ENGLISH MECHANIC are not the men to patronise people who do so. We confidently appeal to our subscribers to support us in the step we are about to take. In all respects they will have a much better article, and those who work for them will do so with a better heart, as they will then, it is confidently hoped, receive a reward commensurate with their labour.

In conclusion, we have simply to repeat that in the next number the size of this journal will be increased—that *The Mirror of Science* will be incorporated with it—that it will be printed on a superior class of paper with clearer type—and, that its PRICE will be TWOPENCE.

"THE YEAR THAT'S AWAY."

WITH however much pride a merchant posts up his balance at the year's end, when he has closed his books and leant back in his chair, there steals into his mind thoughts manifold concerning things left undone, things that ought to have been done, things to do which no chance will ever again present itself. And when these have elbowed their way through the audience chamber of the brain, then gradually steal in thoughts of those who have, like the year closed, passed away for ever, ferried over the dim unsounded stream which margins Time. So we, after passing the year in its varied aspects before us, have also passed before our mind's eye the names of the departed men great or well known in their vocation; though we have thankfully to admit that the list is small compared with those of former years. Among the "passed on" we have to note Struve, the Russian astronomer; Silliman, the well known American chemist; Professor Boole; Neilson the engineer; Cobden, Paxton, Lubbock the mathematician, Parnell the architect, Kiss the Prussian sculptor, Appold the civil engineer, Richardson the lexicographer, Sir Charles Eastlake, and various others whose loss will long be felt, and who will doubtless be long missed from the fireside; for, after all, it is there the loss is longest felt. But while we deplore their loss let us be thankful for much that is good, for much that promises well remains behind to "fall in" to the places in the ranks vacated by the departed.

Few trades have had to mourn bad times during the past twelve months; the close of the American civil war has tended to settle things down, and they are, generally, firmer than they were at this time last year. Mechanics generally have had a fair "spell" of it; this we conclude from having heard no complaints. And the prospects for the year now starting down the incline are more favourable than they were for "the year that is away" at this time twelve months since.

There have been so many improvements in machinery that to notice them would simply be to fill our journal with nothing else. There have been a few "steady-going" improvements in the locomotive, a capital little tell-tale for the state of the atmosphere in mines. Great progress has been made in coal-cutting machinery, and we understand that various others will shortly be before the public. In nail and spike-making machinery there have been sundry improvements, as also in wood-sawing and planing machinery. Rivetting, cutting, shearing, and punching machines and roll-trains have had considerable attention devoted to them, and a capital invention has come to light for cutting sugar in dice of any size at any decided rate per hour; this by Mr. William Muir. In girder-bridge building there have been marked improvements, and the Bessemerising process has become a great fact. Nor has ship building and engineering lagged behind, though the consumption of fuel per horse-power per hour is scarcely the thing yet. Attention has been directed to the burning of oil fuel, and great progress has been made with petroleum, especially in the furnace, which contains two layers of fire spaces to the one used for coal; indeed, hopes are held out that this fuel may yet be found more economical than coal. In agricultural machinery there have been very few improvements, but we are glad to notice that E. E. Allen's engine is receiving the reward it deserves.

But here we must call a halt—our space forbids enlarging on the tempting theme. But everything tends to show how, day by day, the English mechanic becomes more and more valuable, and shows how capable he is to stand alongside the mechanics of any other country. That he is valued, witness the exports of machinery to all parts of the world, and the falling off in some of the imports, the articles of which our own workmen now supply at as cheap a rate and as good as those which used to be obtained from abroad.

On the whole, we have every reason to be thankful for our position, and to strive to better it in the time to come. There is room for it, and we are glad to see the right spirit is abroad. We judge this more from the letters of our myriad correspondents—who date from all parts of the country—than from anything else. They exhibit a rare degree of intelligence, which augurs well for the future. We heartily wish them all success in business, and if they will be but true to themselves and to each other they will achieve success not only in 1866 but in all time coming.

THE PAST YEAR'S INDUSTRIAL EXHIBITIONS.

PROPERLY looked at, it cannot be doubted that industrial exhibitions are a great benefit, to the

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employer as well as the employed. The careful production of even the commonest piece of goods for "show" engenders habits of precision and general care on the part of the workman, which must enhance his value in the eye of a thorough-going employer. And it may safely be affirmed, not only that the man who studies neatness in his "exhibition work" bestows more care on that which he produces for bread than the man who has no ambition to exhibit, but that the man who turns his attention to innovations on things as they may happen to be within his own ken, is also a handy man in the workshop, and gets over many a "shift" which your regular routineer could only sit down and muddle over when difficulty to be overcome came in his way. This, in our own experience, we have always found to be the case; and any one who has taken the trouble to enquire "in and among" workmen at the various exhibitions will have found the correctness of our statement to be beyond impeachment.

Among industrial exhibitions that of the first South London (though not of the past year) claims priority of mention—originating with a Lambeth missionary, Mr. G. M. Murphy, and held in the Lambeth Baths building. Here to exhibit came chimney-sweeps, postmen, sailors, gardeners, corkcutters, and workmen of all kinds. The sweep showed a water-filter of his own improved construction; the postman exhibited a table-cover with nearly 5,000 diamond-shaped pieces in it; a hairdresser came out in plaster-models, and a painter in anti-garotting cravats. So great was the success of the South London Exhibition that one was started for north London, and held in the Agricultural Hall, Islington. It was open for less than three weeks, yet during that short time within a very few of 200,000 persons paid it a visit, and the receipts exceeded the expenditure by £800. There were nearly a thousand exhibitors, and the articles were an improvement on those at Lambeth. In February, 1865, Lambeth Baths was the scene of a second exhibition—a most unqualified success, reflecting credit on all concerned in it—from the humblest exhibitor "only 7 years old" to the president. Various exhibitions followed these, dictated, probably, by different feelings—at any rate they had not the same success. That at the Floral Hall, Covent-garden, was a remarkable failure, that at the Beaumont Institute, Mile End-road a ditto; one held in nearly the same locality—the St. Mary's Schools, Whitechapel-road, met with a different fate. Many of the articles exhibited were of a superior kind, and 50,000 people went to look at and admire them. The one at Wandsworth was a success; here were exhibited an A 1 Berlin wool ship by a bricklayer; headwork by a soldier; violins by bricklayers; boots by a newsboy; and an engine by a hatter! Then there was a Juvenile Industrial Exhibition at the Agricultural Hall, in which Reformatories came out brilliantly. Here was exhibited the Great Pyramid made, as facetiously remarked, by 'Apenny Bundle, Esq. It was built of some 4,000 bundles of firewood, was hollow, and had a goodly-sized room inside. Then there was the Anglo-French Exhibition at the Crystal Palace, which was not a working man's exhibition, and so failed. We have, we think omitted several London minor exhibitions, but we have named sufficient to show that they were, on the whole, a success, where properly managed. But it would be unfair to pass over the fine display at Greenwich, by the sou'-easters. There were some capital pieces of mechanism and of finished works, model and otherwise, which preach a fine lay sermon in favour of the working man. In the country there have been many important exhibitions. At Wakefield there was a very creditable one—in which was a very fine display of "union cloths," the production of Morley manufacturers, and illustrating a new branch of textile industry. Nottingham and Reading also came out very creditably, and Birmingham had one in which there were nearly 800 exhibitors, principally handicraftsmen of the town and outlying hamlets. The exhibition of the Preston folks was so great a success that over £2,000 were cleared after everything was paid for. Bristol produced 700 exhibitors, and some excellent models of yachts and other vessels. Then there was Plymouth and Manchester—a fine display—and lots of other places. A few useful ones cropped out here and there in Ireland, not to mention its great exhibition in Dublin; and Scotland, as usual, is to the front—the one now being held in Glasgow being a fine affair—supported by gentlemen of all positions inside and outside of Glasgow. Though we have gone so far afield we have yet room to notice the Coachmakers' Exhibition, nearly a year since, in Cheapside, which while it went far to show the substantial and useful character of our English coach-makers' work, at the sametime made evident that in matters of design and art they have still a great deal to learn.

One thing was evident in every exhibition, and that was that a fearful amount of ingenuity and patience had been wasted—utterly thrown away. Many things exhibited might be wonderfully constructed but they were hideous abortions. The getting-up of such things is not to be commended. For instance, what is the use of making a chain of half a hundred thousand pieces?—or a counterpane with has many pieces in it and unnumbered stiches? It is simply throwing away valuable time—it is worse than that, it is wrongly using that which is given for quite a different purpose by an Allwise Benefactor.

One great good these exhibitions have done—and that is, it has made master and man rub shoulders often were they might never otherwise have done so; it has brought working men into the society of competitors, and led many to see in what they may have been deficient. What the present year will produce we cannot say; though we believe there are several about to be set on foot, not only in London but in various parts of the country.

We should like to see these grow from regular centres of art or science education. We might then look forward to many working men's works as we do now to those exhibited at the Royal Academy and other artist exhibitions. What our opinions are respecting the ultimate objects of Working Men's Industrial Exhibitions has already been placed on record in these pages; and we see no reason to alter the opinions then expressed;—simply to add that we wish them every success possible in 1866.

PROGRESS OF INDUSTRIAL EXHIBITIONS.

Since 1851 we have become familiar with exhibitions, and the familiarity has probably done something to take off the edge of novelty; but there is a peculiarity about the Glasgow Exhibition rendering it worthy of special attention;—it is mainly the creation of working-men. A number of the more opulent citizens have, indeed, contributed of their "art treasures" to its adornment, but the mass of the contributions are either those of artizans or amateurs. The preponderance of models of the locomotive and steam engine, reminds us that Glasgow is the city of Watt, and that the determination he gave the mechanical arts has left an abiding impress upon its genius. Who first originated the idea of "exhibitions," it might perhaps be hazardous to say. "But there can be no hazard in asserting that to the sagacity and the labours of the Good Albert, was Britain indebted for the splendid success of the Exhibition of 1851. The Consort of our Queen comprehended more profoundly than most men of his time, how, despite the "confused noise of the warrior," ever and anon breaking on the ear of Europe, the age is, after all, essentially an industrial age. The Great Exhibition, over which he presided with such remarkable ability and unwearied perseverance, was the realization of that fact. Glasgow, albeit, the second city of the empire could not expect, in a purely local enterprise, to cope with an enterprise to which the industry of the world sent its wealth. In the London Exhibition there was gathered as into a nest the riches of nations, while Glasgow working-men have only the spoils of a single city to select from. But even in the more modest dimensions this enterprise assumes, the great lesson of industrial exhibitions is taught with a vividness and force that at once arrest the most listless visitor.

The large building in which the exhibition is held at 99 Argyle street, contains four large flats, with ante-rooms. The ground floor of the exhibition contains upwards of one hundred models of stationary and locomotive engines of varied and novel construction, ingenious mechanical apparatus, extensive collection of coloured and photographic mechanical illustrations, specimens of artistic relief, works in malleable iron, &c. Then in the first gallery, in addition to the bust of the Prince Consort and Messrs. Wylie and Lochead's drawing-room, there are groups of statuary, richly inlaid cabinet and glass work, collections of Chinese and other foreign ornaments and curiosities, valuable contributions of articles of *pertu* in gold, silver, enamel, and alabaster, and ladies' fancy work of all kinds. The second gallery embraces an extensive collection, illustrating to a very minute and admirable degree, the sciences of geology, botany, zoology, mineralogy, and ornithology; also, microscopes, aquariums, illustrations of chemical products, electric clocks, and illustrations of the mechanical powers. The third gallery contains contributions from gentlemen possessing the finest art collections in the West of Scotland, and others, embracing Holman Hunt's great painting of "The Scape Goat," Macculloch's "View of the Clyde," Maclise's "Sleeping Beauty," Knell's "Battle of Trafalgar," Maclise's "Scene from Othello," Ansdell's "Return of Montrose from Raid with Booty," and other equally valuable paintings: also, portraits and busts of eminent gentlemen, and paintings, drawings, and designs by working men. In the photographic gallery are specimens of the art from the best-known firms in the profession; also interesting private collections, including—"Scenes from Faust," "Views of the Holy Land," "Views of Scottish Scenery," miniatures, portraits, &c., &c. Ante-rooms are set apart for operatives engaged in the manufacture of needles, glass ornaments, brushes, weaving of plaids, &c.; also, two large glass engines are in constant motion. Arrangements have also been made for exhibiting George Cruikshank's great painting "The Worship of Bacchus."

Such is a sketch of the contents of the Exhibition of Industry, Art, and Skill which has been provided for the vast working-class population of the West of Scotland. It may be stated generally, that the articles exhibited by working people number nearly 1,400; and that the exhibitors belonging to the industrial classes are upwards of 500, showing how general the response has been to the desire of the promoters, to make this a most successful, because interesting and instructive Exhibition. We have no doubt large numbers of the townspeople will avail themselves of this opportunity of viewing one of the finest displays which has been witnessed in the form of a local Exhibition.

REFINING LEAD.—John J. Crooke, of New York, claims the improved process of refining impure lead by treating it while melted with the melted oxide of lead.

ATMOSPHERIC FORGE HAMMER.—An improved and very efficient forge hammer is at present being manufactured by Messrs. Merrill and Sons, of New York. The 10-lbs. hammer occupied but 4 ft. by 2½ ft., and runs with but little noise, and no jar beyond the blow on the anvil or work. The cylinder and hammer move in vertical slides, so that each blow is square, and exactly in the same place; it is under the perfect control of the workman, who can strike light or heavy blows, and at any speed, and it is claimed that the working parts are not liable to get out of order. The hammer derives the increased force of its blows from compressed air. The cylinder is air-tight at each end, and there are two small holes in the side of the cylinder near the centre through which the air passes freely in and out. It will be noticed that the piston, piston-rod, and hammer are entirely independent of the cylinder, and can be moved up and down without moving the cylinder; also, that when the cylinder is moved either way the piston passes the air ports confining the air in either end of the cylinder, which prevents the piston striking either head, and acts as a spring, lifting the hammer up, or accelerating its downward movement. The cylinder has a definite motion, governed by the travel of the crank, but the hammer has more lift, owing to the compression of the air. If the cylinder is moved up and down slowly there is no blow given, as the weight of the hammer rests on the cushion of air, under the piston in the bottom of the cylinder. If the cylinder is moved up quickly the air under the piston strikes and lifts the hammer as quickly, and the momentum of the hammer in its upward motion causes the piston to pass the air ports, and compresses the air more or less according to the speed in the upper part of the cylinder; the elasticity of which, acting as a spring, accelerates the downward motion of the hammer, to which may be added the rapid downward motion of the cylinder following up and crowding the air spring upon the piston, adding to the force of the blow. The blow is controlled by the speed; the sharpest blow is given when run at high speed. It can be run rapid, and strike lightly by lengthening the connecting-rod, which allows the bottom cushion to receive the bulk of the blow. There are no valves to get out of order; the packing is exceedingly durable and easy working; both that in the piston and lower cylinder-head are made of the cup leathers used in packing hydraulic rams, and they have been run for months without perceptible wear

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LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

TEMPERING MILL CHISELS.

me to s a contribution to your Christmas number, allow offer the following for tempering mill chisels, edge tools, springs, &c.:—

1 ounce white arsenic, 1 ounce spirits of salts, 1 ounce sal-ammonia dissolved in four gallons of spring water, and kept in a tube or iron phial for use.

Heat the spring, &c., to a b o.d-red heat, then quench th in this mixture, draw it gently over the clean fire till e spittle flashes off it, then l.t it cool.

The above I have used for mill chisels (without taking down) made from unkind steel, and with success, but have not tried it for edge-tools and springs. Perhaps it may help to solve the question suggested in your late article on Hardening Steel, and in which arsenic is mentioned as the doctor for water.

LUTON.

HOROLOGICAL.

Sir,—I think that many readers of THE ENGLISH MECHANIC would think it a treat if you occasionally gave information on clock making. I myself am exceedingly fond of all connected with the art, and at the present moment am at a loss how to set about making a timepiece, while I am I am certain some of your readers would willingly give me instruction through your pages.

H. NORTON.

[We are willing to insert letters and diagrams for the assistance of our perplexed correspondents.—ED. E M.]

THE EXCHANGE.

Sir,—I am very much pleased to see that you endorse the suggestion of an exchange club, and wish it all success, and trust it will be speedily in operation from personal motives. I think you could occasionally give a sheet of illustration printed from electrotype, taken from finished works furnished by subscribers, to your invaluable journal.

AN ENTHUSIAST.

[This is a capital suggestion, and we are willing to entertain it.]

Sir,—I shall feel obliged if any of your readers can inform me what power engine it will take to work a pair of Pudd bar rollers, say, roughing and finishing; and what power engine it will take to work a double-ended puddled ball squeezer to squeeze two balls at the same time. An answer will greatly oblige, J. THORN.

Tonder Iron and Coal Works, Glamorgan.

Sir,—As several correspondents have of late been asking about the management of steel, I beg to say that I have a little book in my possession which I think may be of some service to brother mechanics. It is the "Management of Steel," by George Ede, 1s., published by William Tweedie, 337, Strand. It concludes forging, hardening tempering, shrinking, and expansion, also the case hardening of iron, &c.

FRANCIS CLEMENS.

Sir,—Allow me, through the medium of your journal, to return my hearty thanks to Mr. E J. Mitchell for his kind answer to my request concerning a steam whistle. The drawing he has obliged me with will suit my purpose exactly. I have also to thank you for your kindness in engraving and publishing.

HENRY WILLIAMS.

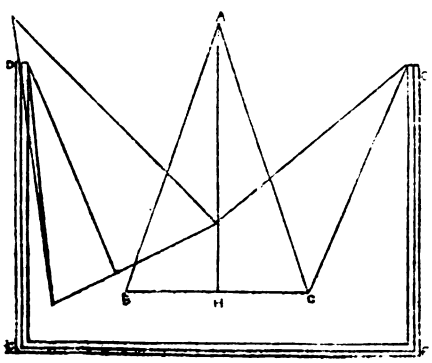
PARALLEL MOTION.

Sir,—Perhaps the enclosed form of parallel motion is new to some of your readers. It is figured in Professor Willis "Mechanics." The equation which he deduces is:—

$$\frac{AH}{DE} = \frac{BC^2}{(EF-BC)^2}$$

Taking EF (in the figure) = 8,
DE or FG = 6, and BC = 4

$$\therefore \frac{AH}{6} = \frac{16}{16} \therefore AH = 6$$



C. SWEET.

Sir,—Your correspondent David Sloan Thompson says that Watt resorted to the star and planet wheels "to render his engine complete without any other person's production," yet he says that the crank was invented by Watt. I beg leave to say that the star and planet wheels were adopted for the purpose of increasing the speed of the crank shaft without increasing the number of strokes of the connecting rod. Mr. Thompson is wrong in either the size of his planet wheel or in his statement that the fly-wheel shaft goes 2 to 1, for the planet wheel, according to his drawing the planet wheel, is twice as large as the star wheel, there fore the star wheel would make four revolutions for one of the planet. If the two wheels were the same size (as they usually are) then the star wheel would make two revolutions for one of the planet.

JAMES SHARPE.

SLIDE RULE.

Sir,—Although desirous, as you well know, to assist as far as lies in my power my fellow workmen, in their struggles upward and onward, yet it can scarcely be expected that I could devote sufficient time, or you devote enough space for teaching them the commonest rules of arithmetic My reply to C. B. M. S. was curt and unsatisfactory, because I considered that a person who could ask a question so well ought to have known better than to ask it at all; but, since it appears from a letter received from another correspondent signed A. B., that there really are some of your readers who do not know why the s ide rule cannot perform the function referred to by C. B. M. S., I have no hesitation in explaining the matter.

In the first place, then, in the conversion of a vulgar fraction into a decimal, we continually multiply the numerator of our fraction by a power of ten, the base of our system, by adding cyphers thereto, and by dividing by the denominator we get a new numerator of another fraction, of which the denominator consists of 1, and as many cyphers as we obtain quotient figures from our division.

Here, then, we have three numbers always given, viz., the numerator and denominator of the vulgar fraction and the denominator of the decimal fraction, to find the numerator of the latter, and the matter become one of the processes of ordinary division.

But, in reversing the process, the question becomes very different, since, if we wish merely to make the decimal into a vulgar fraction, we require no slide rule at all, but merely add unity to the requisite number of cyphers, and the operation is complete, while, to reduce the vulgar fraction to what it was originally (i. e., its lowest terms), we have only two terms given, viz., the numerator and denominator of the decimal to find the numerator and denominator of the vulgar fraction, both of which are unknown, and the only means of obtaining them is to find their greatest common measure (a process often necessitating some fourteen or fifteen separate divisions of one number by another), and then dividing the numerator and denominator of the decimal by the greatest common measure.

In order to show A. B. the stupidity that was wrapped up and neatly folded in the short enquiry of C. B. M. S., I take the simple example given by A. B., converting ¾ into ·75, he is quite correct in his manipulation; but what has he really done?—simply got $\frac{75}{100}$ instead of ¾. Now, if he knew beforehand that the fraction he was seeking had 4 for denominator, then the reverse method would be equally simple with the primary process, but vulgar fractions do not always have 4 for a denominator, and hence he must proceed thus:—

$$\begin{array}{r|l} 75 & 100 \quad 1 \\ & 75 \\ \hline 25 & 75 \quad 3 \\ & 75 \end{array} \qquad 25\,\Big)\frac{75}{100} = \frac{3}{4}$$

Hence is this perhaps one of the very simplest cases that occurs, no less than four separate divisions are requisite, while, in some cases, they extend to 20 or 30 processes, yet C. B. M. S. enquires for a method of doing all of them by one setting of the slide.

I am sorry that Mr. E. Farnsworth should have been at the trouble of sending an answer to me to a question I never asked; but one which I put on its proper basis a fortnight before his letter appeared. I think your better educated readers who feel a desire to rush into print, should read carefully the subject upon which they intend to write. In the present case, all that has been said upon the matter bears no relation to the question as originally put by T. G. Maugh, viz. (p. 52, Oct. 27):—"What is the method of ascertaining the pressure of a steam a boiler can bear by the safety-valve?" I am constrained, from lack of time even now to put this matter in its true light before your readers, but I trust that I may shortly be enabled to do so, as I consider it one of great importance to engineers in general, and more so to those who have to purchase boilers, and work them as a commercial speculation.

With regard to the mere question of the effect of the lever and valve upon the working pressure of a boiler, I trust my last letter upon the subject will remove any difficulty that may come in the way of a juvenile who attempts to comprehend the supposed mystery, but I must say that I was astonished to find one of your correspondents very recently asserting the safety-valve lever to be one of the "second order," an assertion more liable to lead your readers unversed in mathematics astray than all his writing upon the subject would be likely to assist them towards gaining a correct idea of what they are really in search of.

I cannot conclude this paper without calling in question the (to give it its mildest denomination) absurd conclusion given vent to by Jno. Tawse. He states that, "In small batteries when you increase the metallic area you increase the electrical power. This can be calculated up to a certain point; but, when you come to hundreds of superficial feet (as in the shape of a ship's sheathing), the power increases in immense RATIO." Even with the "unfathomable briny" as a menstruum, this must be taken, as Dr. Marigold says, "Cum grano salis." But, and here lies the matter, is Jno. Tawse, although "he talks like a book," prepared to levers are caused to work together by a connecting bar H, and a doubled "Hodge's Accumulation," which goes through the end of the connecting bar, and is linked up to the upper lever end. I prefer this elastic stretcher for the saw, because as the saw heats at high speeds, the elastic stretcher takes up the slack, which used to annoy me by causing the saws to break. I, is the saw table, which, of course, may have a shifting stud on it for cutting circles. J, J, are two pins to keep the frame level.

ELECTRICAL APPARATUS.

Sir,—I beg to offer a mite towards your Christmas Extra Number. Probably many of your young beginners in the Electrical Science are not aware that their small store of electrical apparatus may be very rmuch increased by the possession of a "Secondary Battery" by which we have the power of producing very powerful effects, both as regards quantity and intensity, at a very small expense, but it must be understood that which we gain in power we lose in time. But, as time is no object to an amateur, I will proceed to describe the construction of one to be made of sheet-lead only:—

I will premise that the amateur is in possession of four or five smallest size Daniell's batteries. If not, three small-sized Bunsen's or Smee's will do.

Procure two pieces of sheet-lead (the thickness is of no importance) about 2 feet long and 6 inches wide; let these be separated by a sheet of a non conducting material, and then roll the lot lightly together, taking care that each sheet of lead is thoroughly separated from each other; cut a strip of lead from each sheet to serve as a connection to the Daniell's or any other primary battery. Having done this, place the roll of lead into a jar, and fill up with sulphuric acid and water—1 part acid and 7 water. Now have the primary battery in readiness, and connect one sheet of lead (by the strip cut off) to one pole of the primary battery, and one to the other pole. After the first connection to the primary battery has been made, the same sheet of lead must be connected to same pole whenever the operation is commenced again.

Having now connected the secondary battery to the primary battery let the current work for half an hour (and here is where we loose the time, but we shall gain much in power, as will be seen); at the expiration of this time disconnect the primary from the secondary. Now, to show the power that has been gained, try to burn a piece of iron wire with the primary battery, and you will find that it cannot be done. Now try the secondary battery, you will find that we have increased the quantity, at least, three times without any more expense (for the lead is not acted on in the secondary battery). The power of the secondary battery will decline gradually, but it must be understood that another secondary battery may be connected to the primary battery during the time we were using the one that was first charged. I have only to add that twenty o: these secondary batteries, properly connected, will produce the voltaic arc of light, and no expense but the primary battery. I need not suggest how three or four secondary batteries, after being charged, may be connected for intensity, and used for charging other secondary batteries. If this trifle meets your approval, I shall have much p easure in sending you a description of one even more powerful than this, and which may be charged from one primary battery and a primary coil of wire.

ANION.

MICROMETER AND EQUATORIAL MOUNTINGS.

Sir,—It would be impossible to give an intelligible description of the equatorial mounting of a large reflecting telescope without numerous diagrams, which could only interest a very limited number of your readers. But if T. W. B. would make a proper application to the Council of the Royal Astronomical Society, he would probably be permitted to inspect Mr. Lassell's photograph and description of his mountings, at their rooms at Somerset House, where he would also see other models, and might obtain information which would be very valuable to him.

With regard to what he calls the "double position micrometer" (by which he evidently means the double-image position micrometer) the following directions will enable him to employ it. I assume, of course, that the telescope with which he is using it is equatorially mounted. Supposing that he has the instruments before him, he will find it to consist of a position circle, and an eye-piece containing four pieces, of which the the third (from the eye end) is bisected, and one of its halves movable by a micrometer screw. When the two segments of this lens are accurately in the position which they occupied before the lens was cut, the eye-piece will transmit but a single image of a star, the micrometer head should then read O, as should the little scale on the pointer, which shows the number of whole revolutions made by the screw (This last adjustment is made by the maker, the first is perfected by twisting the micrometer head round on the screw, when there is but one image visible). Now, then, let T. W. B. put in the eye-tube with the wire stretched across it, which will be supplied with the instrument, direct the telescope to a star, separate the images, and turn this eye-tube until the wire bisects these images. Then set the vernier to 360° on the position circle and keeping it there, turn the entire micrometer, circle and all, round in the eye tube of the telescope until the star continues bisected by the wise when the telescope is moved up and down upon the declination axis. The zero of the position circle is now in adjustment.

To find the value of the micrometer screw, turn the micrometer by means of the milled head, until the vernier of the position circle reads 90° separate the images of a star any number of revolutions—say 10; and having securely clamped the telescope, note the interval of time between the passage of these two images over the wire. This in seconds of time × 15 × cosine of the star's declination will give the value required in seconds of arc; whence the value of one revolution of the screw, or one division of the

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micrometer head may be immediately obtained by simple division.

To measure the position of a double star: separate the images, and turn the position circle by means of the milled head until the four stars are in a straight line—the vernier will show the angle of position.

To ascertain the distance, calling the stars A and B: Place A upon B, and B upon A alternately. The mean of the readings will give the distance.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

OUR SUBSCRIBERS' NOTES AND QUERIES.

THE STEREOSCOPE.—Will any reader inform me the best method of preparing pictures for the stereoscope, and for colouring and varnishing them?—AMATEUR.

CIRCULAR SAWS.—Will any reader kindly inform me the address of any maker of small circular saws about 8 inches in diameter, the teeth not like joiner's saws, but about half an inch long—say two teeth to an inch, and project 3-16ths?—A JOINER.

ADDRESS WANTED.—Can any subscriber inform me the address of M. Rhumkorff, a philosophical instrument maker in Paris?—C. G. M.

WHEELS.—Can any reader tell me the best mode of making level wheels?—JOHN MILAN.

DOUBLE TREADED WORM.—Can any reader tell me how to draw a double treaded worm?—ONE IN A FIX.

SOFTENING IVORY.—Can any reader inform me of a method of softening ivory, so that designs can be impressed upon it? I have some recollection of a description of the process being given in one of the scientific journals, but the name has quite escaped my memory. I shall feel very grateful for any information on the subject.—JOHN MCMURRAY.

ELECTRO MAGNETIC ENGINE.—I am about to construct an electro-magnetic engine, to be worked by two magnets, with fly wheel and crank. I intend placing the magnets opposite each other, which will attract alternatively a piece of iron connected to a crank, and thus propel the fly-wheel. If any reader could assist me with any suggestions, they will be thankfully received by—E. MADDOCK.

PAINT AND STEAM POWER.—Can any correspondent tell me how to make a black paint suitable for the smoke box, chimney, &c., of a portable steam engine? It must be cheap and must be able to stand heat. Also, if a steam-engine, say 10-horse power, be put to do the work of a 5 horse power engine, should it require any more fuel except so much as the increased weight of engine would require to move it? It seems to me that a certain amount of heat should give a certain amount of power, but I find that in two engines of the same construction the 10 horse-power requires two or three hundred of coals per diem more than the smaller one, and is doing no more work. How is this to be accounted for?—F. H. T.

ALARUM.—Will some correspondent inform me how I can construct an alarum calculated to awaken at any hour without clock or watch being used. I am aware they are constructed to act with sand or water, but I don't know the way to do it?—J. M. K.

Can any reader inform me of a rule to find the quantity of water evaporated per hour to feed an engine with steam; cylinder diameter 22 inches, 4 feet strokes, speed of piston 330 feet per minute, boiler pressure 80 lbs. average pressure in the cylinder, 15 lbs. per square inch?—W. H.

WATER POWER.—Perhaps some reader will tell me the best method of obtaining a small working power from a town water supply, say a common water-wheel or turbine wheel?—SCOTCH MECHANIC.

BATTERY.—Can any of your readers inform me how to make a thermal electric battery?—CHIPS.

HYDRAULIC.—Can any reader inform me how much more water will be forced through a pipe (say 1-inch in diameter) by giving two, three, or four times the pressure? For example, I get, say, 50 gallons a minute from a body of water 10 feet high, how much should I get with a pressure of 20 feet, 30 feet, and 40 feet high?—GREEN.

GUN BARRELS.—Can any reader assist me with a recipe for boring gun barrels so as to bring the twist up?—SPORTSMAN.

FURNACE.—I am a smith, and am anxious to make a trial at the castings in connection with my work. Will any reader assist me to the best method upon which I can construct a small furnace cheaply?—GEORGE NEILSON.

GAS HOLDER.—Can any reader tell me the weight of a gas holder nine feet diameter, by thirteen in depth, made from plate 5-16ths thick, allowing 1-16th for waste in making, which would leave 4-16th thick.—BETA.

INDIA RUBBER CLACKS.—Can any reader inform me where I can purchase the India-rubber clacks for pumps, pumps, and what about the price.—T. H. C. R.

TELEGRAPHIC INSTRUMENTS.—In No. 28, Vol. II, you gave an article on our "Telegraphic Instruments." I embrace the opportunity to gain a little insight into them. A few days ago I had a look into what is called a single instrument. It worked with a hand like a clock. Now, what I want to know is, how the electric current is conveyed through the instrument and made to act with such precision in connection with the hand?—CINA.

PHOTOGRAPHY.—Can any reader oblige me with information as to the best artificial light for taking photographs during the winter evenings, and the different chemicals used for working by sunlight?—LENOX.

Can any reader inform me how to preserve mathematical instruments from rust without using oil or grease?—R. J. T.

I have an improved plan for a screw propeller for propelling ships. Will any correspondent inform me the best way to get a spring to drive a model from four to five feet long?—A. GOODWILL.

ELECTRICAL MAGIC PICTURE.—Could Mr. Tonkes or any of your electrical correspondents inform me how to make the electrical magic picture and the inclined plane?—J. WOOD.

REPLIES TO QUERIES.

OVAL CHUCK.—In reply to G. H. D. in No. 39, I feel hardly competent to instruct him, for I am but a mere amateur. If, like myself, he has constructed portions of his turning apparatus, as I judge he has, I might afford a hint or two; but if he has always depended upon his lathe maker for alterations or additional mechanism, or is not acquainted with the principle of action and usual construction of oval chucks, then I should have to enter into such lengthened details as would occupy too much of the valuable space of THE ENGLISH MECHANIC. I would, however, recommend G. H. D. to apply to Messrs. Holtzapffel, first, at their establishment in Cockspur-street, Charing-cross, where under the name of a turning lesson at two shillings per hour, he will feast his eyes on the perfections of endless apparatus, and be attended by superior and gentlemanly workmen to explain and simplify the same, and answer every question he can put to them. Afterwards let him go to the manufactory of the firm in Long-acre, where they will instruct him on the same easy terms in the mysteries of filing, planing, surface testing, steel screw turning, boring, slotting, hammer hardening, polishing, curling, &c. If, however, G. H. D. should prefer my inferior suggestions, let him say whether his mandril has a hollow or a projecting screw for fixing its chucks; height of its centre from the upper part of lathe bed, and the diameter and amount of precision required in his oval work.—CENCINO.

FRET SAW.—On the 22nd ult. Wheelwright wished information respecting a fret saw capable of cutting in felloes and centerings; in answer to him I am about to erect one designed by W. Sketchley, Great George street, Weymouth, which I am of opinion will suit his purpose admirably. The table can be adjusted to any angle required, and is also free to turn any size plank on it at any radius. If Wheelwright will write or call, I shall be happy to give him any information. I have no interest in the saw being advertised.—W. J. DAW.

21, Clarendon-road, Notting-hill.

IVORY STAINS.—T. Simpson. Stain may be imparted to ivory in the following manner:—Blue.—Immerse in a strong solution of sulphate of copper until it is the tint required. Black.—Soak in strong solution of logwood, and then steep in solution of acetate of iron. Green.—Boil in solution of verdigris until dark enough. Red.—Steep in red ink until sufficiently stained. Scarlet.—Use lac-dye instead of preceeding. Yellow.—Impregnate with nitro-hydro-chloride of tin, then digest with heat in a solution of fustic.—T. ALLEN.

PLANET MOTION.—I beg leave to inform David Sloan Thompson, through the medium of your valuable periodical, that in his description of Watt's sun and planet motion, he made a slight mistake in showing a bar connecting the two wheels. In the original motion invented by Watt, the teeth of the wheels simply worked into each other without any connection.—WILLIAM H. THOMPSON.

CASE HARDENING IRON.—Use bichromate of potash, instead of the prussiate, with the pith of rams' horns, (some use hoof-parings), cut in small pieces, and laid on the hot surface to adhere, sprinkle on the bichromate in powder, while turning the iron round with the tongs. The best file in the world won't touch it.

SOFT SOLDERING.—Copper, pewter, tin, lead, and brass, can be soldered with spirits of salts (which has been "killed" with zinc), for a flux. This will solder anything but zinc itself, for which free acid must be used. The killed spirits may remain open to the air for weeks without deterioration.—G. E. CRICK.

Brittle asks, in your excellent publication (Dec. 15th), why the glass tube of a water gauge, or a steam-gauge breaks some hours after it has been cleaned with a wire, and when quite cold? I beg to say in reply that it is because the wire sometimes scratches the "skin" of the glass, and the fracture thus commenced imperceptibly extends itself until the tube finally breaks. The skin of glass is a thin pellicle which lines or covers its surface. If the glass be carefully annealed, this skin becomes part and parcel of it, and is no longer liable to the casualty named. Under favourable circumstances the skin of glass may be seen detached, and is then found to be an extremely fine substance like goldbeater's skin. German glass is, as a rule, better adapted for tubes, such as those named by Brittle than that of English manufacture.—JOSEPH NEWTON.

WATER IN PIPES.—In reply to Johannes' question, I beg leave to say that the cause of the water is that the pipes are not laid level, and the best cure is a dry meter, but should this be to much expense, he must find where the water lays and insert a piece of pipe in such a manner that the water will drain into it. Will any of your kind readers inform me how to construct a pair of opera glasses that when extended to their greatest length will be from six to ten inches in length. The size of glasses, price, and where to be obtained in London; also, an explanation of the model of the engines of the minotaur alluded to in No. 39 of your valuable paper?—A. YELDAR.

LENSES.—I beg to inform Recius that he can get lenses for a cheap microscope from J. Cox, 22, Skinner street, Snow-hill, London. Mr. Cox will forward a catalogue of lenses to any one for 2 stamps. I can fully confirm all that a Fellow of the Royal Astronomical Society said about non-achromatic single lens eye-piece telescopes. I made one myself a few years ago; I was so disgusted with its performance that I only looked through it once in that state, I then fitted an eye-piece to it (composed of two plane convex lenses) belonging to my microscope, it then showed Jupiters moons very well, but it was very awkward to use without a stand, being about 6 feet long. I then thought about making a stand for it but found that it would cost more money to make one to carry the thing than it was worth. I then made a 2½ achromatic one which is all an amateur can desire, it will show Polaris as times. It is unnecessary for me to inform your readers how to construct a telescope, that having been done. By the annexed price list they may see that they can make for themselves for a little more money an achromatic telescope, of one-half the length, double the power, and with good definition, which will always be a source of pleasure to them instead of disgust. The above is the experience of OLD CHARLIE. From Slug's list, 244, Shetford-street, Manchester. Achromatic glasses fitted in cells—

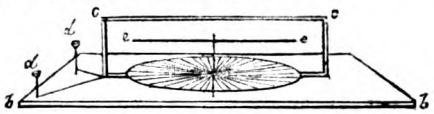
1½	diameter	38 in. focus	5s.
1 1-16	"	30 to 36 "	9s.
2	"	36 to 40 "	12s.

Single lenses for eye pieces. ½, 1, 1½in. each, 1s.

CYCLOPS.—The increase would occur in all metals that oxidise in the fire. The copper may have absorbed a little carbon, but far more oxygen.—G.

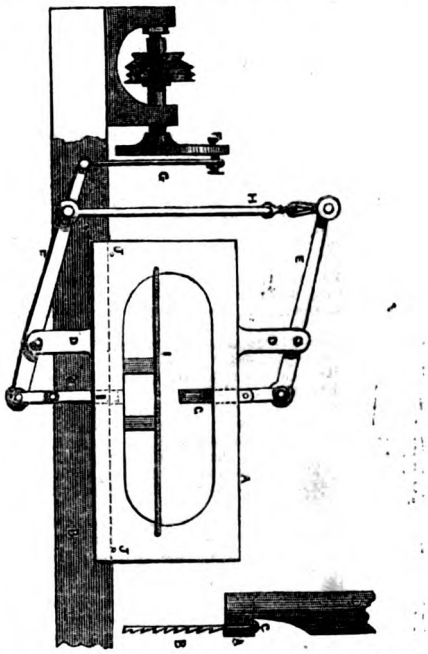
GULLIVER.—Wax and tallow will answer, when the cells are new, made warm, and applied on the inside. You can do no good with cells when the acid has got in.—T.

Allow me in reply to A Student, to describe the following very simple, yet efficient galvanometer:—



Let the point of a fine needle a, project about a ¼ of an inch from the centre of a board b, about 6 inches square. Let about 3 yards of No. 35 silk covered copper wire be coiled around any convenient form, so as to produce a quadrangle c, about 3 inches long by ¼ high, care being taken to leave the two extremities of the wire free. Let stability be given to the quadrangle by tying its four corners. The coil must then be fixed on the centre of the board b, allowing the needle to pass through the middle. Two small mercury cups d, d, are then to be screwed on the board, in electrical communication with the free ends of the coil c. A circular card, corresponding in size to the inner dimensions of the coil, and divided into 360 equal parts, is then to be passed over the under portion of the coil allowing the needle to protrude through the exact centre. Lastly, a well magnetised noedle e, provided with a delicate pivot, is to be nicely poised on the point a. The show and prove (which is of still greater import) that any such law of electrical manifestation exists? Now, more than myself would hail with delight any such proof forthcoming from his pen, and there will be few readier than I to reduce him to his proper status if he has ventured to give publicity to such a statement contravening all our pre-received ideas and laws of electrical excitation without the necessary proofs founded, at least, upon actual experiment. WM. TONKES.

FRET SAW.—According to promise, I send a sketch of the fret saw, and seeing another inquiry from a Wheelwright, as to whether it will cut felloes, &c.; I have to say that by driving it by a flywheel as some heavy lathes are turned, by a man at a crank handle, hard wood of considerable thickness may be cut. I have with the slow motion, and sweep saw cut four inch hard wood, so your correspondent may judge accordingly.—THOS. E. MERRITT.



A, is the frame, fitting between the beds of the lathe B, the fore part of which is shewn removed, to allow the levers C, C, to be understood; C, C, are two brass cylindrical rods, the lower end of the upper rod being undercut, as in fig. 2. The upper end of the lower rod is also undercut, and a saw kerf is made at A (fig. 2), for the purpose of fixing the fret saw tightly in the ends of the rods; the ends of the fret saw being thrust into a drop of melted solder, which gives a hold for the saw in the saw kerf. The rods C, C, slide up and down through the frame A, and are driven by levers E, E, which are pivotted to the standard D, D. An extension of the lower lever is connected to the driving chuck F, by a driving rod G. The aforesaid

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whole apparatus, with the exception of the cups d, d, ought to be covered with a glass bell. If the coil be now brought parallel to the needle and communication be made with any source of electricity, by means of the cups d, d, the needle will be deflected a certain number of degrees; and *cæteris paribus*, the stronger the current, the greater will be the deflections. Should greater delicacy be thought desirable, the magnetic needle ought to be suspended by a single filament of silk, instead of being poised on a pivot. —S. BOTTOM.

PHOTOGRAPHY.—The Bath.—In answer to a correspondent's inquiry, E. J. Atcherley, in your No. for the 22nd ult. I would recommend him to filter his bath through cotton wool, which should be first moistened with a little alcohol, and then pressed pretty tight into the neck of the funnel and then draw through from the bottom with the mouth so as to get a passage, and do not use kaolin, as it is not required. It will generally take 8 to 12 hours to pass through, and when once in use will keep so for months. I have met troubles the same as described, and found the above the remedy in my case; but he does not say whether his bath is made up with anything but silver and water. It may not answer in his case, at any rate, it is worth a trial, and being a practical photographer of 9 years, I shall be happy to help your correspondent if it does not answer, and he will send further particulars through your paper.—HENRY MORTON.

WOOD STAINING.—Parian may imitate ebony by staining his wood, in the first place, with a hot saturated solution of logwood, containing a little alum; and, when dry, brushing it over with common writing ink. I made a very successful imitation of ebony the week before last by this process, with pear-tree wood. I cannot help him about gilding and marbling.—AN AMATEUR TURNER.

LENSES.—I may answer Gladiateur's enquiry about lenses by saying that an achromatic object glass only, will bear anything approaching to powers of 300 or 600; and that he will scarcely obtain one under 60 or 70 guineas to perform decently with this last amount of amplification.—AN AMATEUR TURNER.

TELEGRAPH CABLES, &c.—In reply to question of Veritas: 2386, 29th September, 1863, and 2015, August 4th, 1865, not sealed yet.—T. G. M.

GAS.—Johannes asks the cause and remedy for water deposited in gas pipes; as it would require a long article to explain it, I recommend him to buy Mason's "Gas Fitter's Guide," price 1s; published by Mr. Hill, 54, Murray-street, City Road.—JAMES SMITH.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

W. E., (Design for Boiler).—We have to apologise for delay in answering. Do you think you could utilize all the heat developed? We doubt it, though this may look to you a funny statement. We are of opinion that an undue strain would be exerted on the boiler plates at section c, d, provided your drawing is correct, for according to it one can see that at certain temperatures, that is, the maximum of variations, there would be a strong tendency to getting out of shape, if priming is not to be added. But we are inclined to think the drawing is in fault; and, if so, then we think your boiler will be able to get up steam very rapidly. Your "alteration" is a very simple one, and we are inclined to think it new.

J. GORMAN.—Cut off earlier; 30 cwt. is the weight.

P. SYMES.—You have not complied with the specification, and the award, under the circumstances is perfectly correct. What you say is simply matter of opinion, not of action.

N. GREGORY.—It is now a very common practice. They are let out at £1 and 3s. a month.

P. FOXE.—His address is at the Mint, Tower-hill. A letter will be sure to reach him.

M. Parkes.—You don't believe in the effect of friction! We can't help that. An author may write you a book, but he cannot make you the brains to understand. Take a bit of steel, hold it on the burnisher of your polishing lathe for a while, whilst you work the treadle briskly; you will very soon find out what friction will do for your hand.

A. ROSS.—Advertise in our columns. We cannot insert your communication, as it is an advertisement.

NEMO.—Messrs. Tennant, of Glasgow, and Newcastle, distil their sulphuric acid in platina stills to separate a little lead from it dissolved during the process of manufacture. To detect sulphuric acid in vinegar, add a little solution of nitrate of baryta. A white powder of sulphate of baryta will be precipitated. This, we believe, is a common test.

L. HUMPHREYS.—Holman is the patentee, and has often exhibited.

E. DALRYMPLE.—The register you require is published at the Patent Office, and that up to 1853 is charged 10s. That for the year following is also to be had at about 2s. or 4s. Stamps to Mr. Woodcroft will fetch them for you.

F. GJER.—The English engine used for the Mont Cenis line is that of Mr. Kell; its peculiarity is the mid-rail, to gain adhesion. It is a success.

GEORGE NEISON.—The number of the specification in the current year.

C. LUCK.—Thanks, but too late; we may perhaps find room in a future number.

W. JARDINE.—Perhaps we may treat on the subject in a future number, several thousand copies were excellently printed, every letter clear.

M. V. HEGO.—A good idea, submit it to some practical firm.

CINA.—Under consideration.

ROTARY ENGINE.—Read the works published by Spon, Bucklersbury; Weale, High Holborn, and Virtue, Amencorner, Paternoster row.

TURBINE.—Write to Mr. Middleton, at Loman-street, Southwark, as to cost. Other boilers can, of course, be made, but they must be of an entirely different construction.

A. B.—Letter forwarded to Mr. Tonkes.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

SCIENTIFIC NOTES.

The Royal Society of Fine Arts of Gand has determined upon a grand international exhibition of photographic objects. It will be under the joint patronage of the Belgian Government and the town. Communications should be addressed to M. de Wylder, a Gand.

C. Schrœder Van der Kolk, son of the great anatomist, has just published a work entitled, "Soul and Body" (Seele und Leib), in which he endeavours to prove that what is called soul is simply the manifestation of brain, just as digestion is the function of stomach. He says, memory, imagination, reason, and even volition, are but the result of physical actions, or electro-molecular, excited by the operation of preception—the contact with the outer world.

M. I. Nicles has just announced a new re-action, by which cane-sugar may be distinguished from glucose. If cane-sugar be enclosed in a tube with anhydrous or hydrated bichloride of carbon, and maintained for some time at a temperature of 212° Fahr, it gradually alters in colour; first becomes slightly brown, and ultimately becomes tany in appearance and consistence. Under similar circumstances glucose does not change colour.

In the course of the controversy upon the subject of London milk, which took place at the last meeting of the Society of Arts, Dr. Voelcker, who may be regarded as our best authority, stated that London milk is decidedly inferior to that from the country. In London the cows have more food rich in fatty matter, which yields a milk richer in butter than that of the country. However, the article sold to the consumer is very different, one-third or one half water, after the cream is taken off. For his own sake, he was sorry to say he did not believe in the alleged absence of adulteration in London milk, and he had analyzed many specimens. The specific gravity test is, as a rule, a good one for the protection of the consumer.

CHLORINE WATER.—It has long been known that in chlorine water exposed to air and light hydrochloric acid is formed. Millon has lately shown that some hypochlorous acid is also produced. More recently Barreswill has proved the formation of some perchloric acid under the same circumstances, which observation has been confirmed by Schmitt. —*L'Institute*, 1865, p. 231.

PREPARATION OF IODIDE OF POTASSIUM.—Fuchs places 100 parts of iodine in a porcelain dish with 260 parts of distilled water, and adds thereto 75 parts of pure carbonate of potash and 30 parts of iron filings. The mixture is well stirred together, and allowed to stand. The action proceeds slowly by itself, but hastened by the application of heat. When the evolution of carbonic acid has ceased, the mixture is evaporated to dryness with continual stirring. It is better to allow the mixture to stand for some time in a lukewarm drying oven until all the iron is peroxidised, and then evaporate to dryness. The dried mass is then placed in an iron vessel and heated to a dull redness. The residue is then extracted with the smallest quantity of distilled water; the solution, which has usually a alkaline re-action, is then saturated with hydriodic acid, and set aside to crystallise.—*Dingler's Polytech. Journal*, Bd. 177, s. 251.

Dr. Joule records a very sensible action of the aurora borealis upon the magnetic needle. The needle becomes violently agitated, and undergoes in the course of a minute thirty-six changes of deviation, varying from 10′ to 1 60″. The cause of the movement seems to be instantaneous in its action. When the aurora appears to the west of the magnetic north, the needle is deflected toward the east.

The Rev. Mr. Bowditch's apparatus for improving gaslight is attracting attention. Dr. Grace Calvert mentioned it in one of his Cantor lectures last session, and it has been tried with satisfactory results by experimentalists in different parts of the country. Briefly, the apparatus may be described as a tight metallic vessel, containing oil, or naphthalin, or whatever hydrocarbon may be used. The gas enters by one opening, passes across the surface of the liquid, takes up its vapour, and escapes by another opening to feed the burner. As the flame is placed below the vessel or holder, the contents are vaporised; hence the passing gas finds material already prepared for enriching the light. The amount of improvement is remarkable; for, with the addition of about thirty grains only of naphthalin vapour to one foot of gas, the light is increased seven or eight times. With oil, the result is lower, not exceeding from four to five times; but even this is an important gain. Mr. Bowditch has made numerous experiments at his residence at Wakefield, and among the practical conclusions which he has worked out, the following may be selected as highly satisfactory; namely, that with his apparatus, one gallon of oil worth 2s. will produce with 1,000 feet of coal-gas such has is used in London, more than would be given by 4,000 feet of gas; the cost being in the one case 6s. 6d., in the other 18s.

ARTIFICIAL IVORY.—The *Mechanics' Magazine* says that the process by which the most successful imitation of natural ivory is obtained appears to consist in dissolving either india-rubber or gutta-percha in chloroform, passing chlorine through the solution until it has acquired a light yellow tint, next washing well with alcohol, then adding, in fine powder, either sulphate of baryta, sulphate of lime, sulphate of lead, alumina, or chalk, in quantity proportioned to the desired density and tint, kneading well, and finally subjecting to heavy pressure. A very tough product, capable of taking a very high polish, is obtainable in this way.

PRINTING IN THE DARK.—A correspondent sends us (*Photographic News*) a curious illustration of printing in the dark. A piece of sensitive paper being contact with a printed bill, in the darkness, presents a perfect transcript of the bill, the white portion of the printed bill being on sensitive paper a pale brown, and the letters a yellowish white. Our correspondent says:—"The enclosed is a piece of paper sensitised on a 20-grain gelatine bath, on Saturday. The same night it and some more was rolded up by the boy in four thicknesses of paper (the innermost one being a common printed bill), and put in the bottom of a counter drawer, and covered by a large book, thereby keeping all light and nearly all air from it, as I expected; and, this morning, when opened out, the piece with sensitive side next to the bill received the impress ion which you see."

ADVANCE IN THE PRICES OF PHOTOGRAPHIC APPARATUS.—We understand that there is a possibility of an advance in the prices of photographic apparatus imminent. The cabinet-makers engaged on this work have held a meeting, and resolved on memorialising employers for an advance of 10 per cent. on the present rate of wages. This will be the preliminary, we believe, to a strike, in case the request be not complied with. We can readily sympathise with the plea upon which this effort is made. It is alleged that the necessaries of life have, of late, increased much in price. This is undoubtedly true, and will press hardly on all whose income is a fixed sum, determined at a time when money was more valuable and food cheaper. We should deprecate a strike, however, for the sake of the workmen themselves. They already receive, we believe, a higher rate of wages than cabinet-makers not connected with photography, and a strike would probably bring a number of other men into this branch, who would require a little training, it is true, but who would eventually, probably, by increased competition, reduce the wages below the present standard. We cannot pretend to advise definitely in the matter. We believe the employers will consider this question fairly, and should they see the propriety of complying with the demand, photographers, we presume, must be content to pay a slightly advanced price for cameras, &c.

PHOTOGRAPHY AND THE PRINTING PRESS.—The *Pall Mall Gazette* has the following paragraph on some new process in which photography is concerned, but how does not seem clear:—"Messrs. Sampson, Low and Son's illustrated edition of 'The Pleasures of Memory' is remarkable as introducing specimens of a new method of pictorial art. They are produced without the aid of an engraver. The drawing is made with an etching needle, or any suitable point, upon a glass plate spread with collodion. It is then photographed upon a prepared surface of wax, and from this surface an electrotype is obtained in relief which is printed with the type.

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If this process could be carried out successfully it would give us an important advantage; the artist's own work would be preserved; whereas, even in good wood engravings, it is always marred more or less. We do not know whether in the book before us we have the first adventures in the process, but if so, the results are by no means discouraging. Some of the illustrations are poor, but others—notably, the figures on pages twelve and forty, and a striking bit of landscape on page twenty-eight—show that the method has distinct and peculiar advantages."

REVIEWS.

Lives of Boulton and Watt. Principally from the original Soho MSS. Comprising also a History of the Invention and Introduction of the Steam Engine. By SAMUEL SMILES. London: Murray, 1865.

To few can a history of these two men be more interesting than to the readers of this journal of British Mechanics; and any work claiming to be a history of them deserves attention at our hands. Mr. Smiles has grown quite a bookmaker, and his name is now as "familiar in our mouths as household words." As to the correctness of his books—that is quite another affair. He was not particularly successful over George Stephenson; concerning that of Watt, we cannot see that it was at all wanted. "Lives" of Watt are as plentiful as blackberries in summer, and that by Mr. Muirhead—the intimate friend of Watt, and Boulton's son-in-law—is so admirable that we scarce can mention it in the same line with Mr. Smiles's effort. Still, as a book, the one before us is very readable; and the reviews of it we have noticed in the press could not well have been more favourable to its author if he had penned them himself. Comparing the two works, we would not only sooner have that by Mr. Muirhead, but we think Mr Smiles is greatly indebted to that gentleman for much of his material. We need say but little concerning Watt; every schoolboy is acquainted with his life, and every cyclopædia of any pretensions has a fair memoir under the letter W, or the article on the steam engine, to which, by the way, Mr Smiles devotes much room in the early part of the "Life." The commencement of the book is encouraging:—"When Matthew Boulton entered into partnership with James Watt, he gave up the ormolu business, in which he had before been principally engaged. He had been accustomed to supply George the Third with articles of this manufacture, but ceased to wait upon the King for orders after embarking in his new enterprise. Some time after, he appeared at the Royal levee, and was at once recognised by the King. 'Ha! Boulton,' said he, 'it is long time since we have seen you at Court. Pray, what business are you now engaged in?' 'I am engaged, your Majesty, in the production of a commodity which is the desire of kings.' 'And what is that? what is that?' asked the King. 'Power, your Majesty,' replied Boulton, who proceeded to give a description of the great uses to which the steam-engine was capable of being applied."

And then we make the acquaintance of Hero, and a lot of excellent material given years ago, by Mr. Muirhead, with this difference, that we are reminded now and again how the "black-looking stuff" grew into the "three black crows." We object to Boulton taking precedence of Watt, for though he was a man of energy, mechanical knowledge, and ability, he is not entitled to a prominent place amongst engineers, and he never claimed it. It generally remains for ancestry or folks desirous of making a stir to set up such claims; and we have ample proof of this in connection with George Stephenson. That Boulton was a credit to Birmingham is gladly acknowledged by all who know anything about him, and that he was a sagacious man is evidenced by the readiness with which he recognised the merits of Watt's improvement on the steam engine. Furthermore, he staked heavily on it while its success was yet a thing to be achieved. It may safely be stated that no inventor ever met with a more energetic and liberal capitalist for a partner than Watt met in Boulton. In character the pair presented a strange contrast. Watt was a cautious, "inexpensive" man as to business concerns: Boulton was bold, sanguine, rash; Watt was timid, Boulton afraid of nothing. It may be noted here that Mr. Smiles has the credit of bringing before the reader the ill-feeling that at one time existed between the two partners. That ill-feeling, however, was but transient, and vanished with the success of the steam engine. It appears that the quarrel between the pair arose through Watt's refusal to join Boulton in a scheme for "raising the wind." "When I reflect," Boulton wrote to a London friend, "on Watt's situation in 1772 and my own at that time, and compare them with his and mine now, I think I owe him little." "I some time ago gave him a security of all my two-thirds, after paying off (the bankers), from which you may judge how little reason he has to complain. He talks of his duty to his wife and children; by the same rule I ought not to neglect mine. His wife's fortune joined to his own did not amount to sixpence; my wife brought me, in money and lands, £28,000. I advanced him all he wanted, without a security; but in return he is not content with an ample security for advancing nothing at all but what he derived from his connection with me." This was ungenerous—showed too much consideration for the "capitalist," but as we have said, it blew over; and Mr. Smiles is entitled to the credit due to resuscitating the unpleasantness. That Mr. Boulton was a just man is not to be doubted—and he did ample justice to the man who was more than partner, who was a firm friend; and the two lived affectionately together until the great divider stepped in to separate them. Though Watt was devoted heart and soul to science, he yet had moments of other "inspiration," concerning one of which a friend says it was an eminently "Scotch inspiration"—the bawbee. Writing to Boulton in 1779, he says:—

"Hallelujah! Hallelujah!
We have concluded with Hawkesbury.
£217 from Lady-day last,—
£275 5s. for time past; £157 on account:
We make them a present of 100 guineas.
Peace and good fellowship on earth:—
Perrins and Evans to be dismissed.
Three more engines wanted in Cornwall:
Dudley repentant and amendant.
"Yours rejoicing,
"James Watt."

The following is not bad:—"In the case of an engine supplied to F. Scott and Co., to work a hammer, it appears that instead of applying it to the hammer only, they applied it also to blow the bellows. The consequence was that it worked both badly. They had also increased the weight of the hammer." Watt of course heard of this, and wrote to say that the "defect" might easily have been foreseen, and that "the only adequate remedy is to have another engine to blow the bellows. It is impossible that a regular blast can be had whilst the engine works the hammer and bellows, without a regulating belly as big as a church!" "They have been for having a pocket Bible in large print!" Again, certain plans of the Handsworth parish church (which was about to be enlarged) were sent to Watt, when he was a big man, residing at Heathfield, for his approval. After looking them over, he remarked, "If these plans be carried out, preaching at Handsworth will be like squirting the word of God through a keyhole;" a remark which says more for his style of expression than for his taste.

On the whole, we like and we don't like Mr. Smiles' book. We like it for much of the matter concerning the two men; we don't like it, because all that can be said has already been well said by Mr. Muirhead. In fact, the book was not wanted; and we have no genuine affection for anything superfluous, however handsomely got up. Those who have not got a cyclopædia, or have not Muirhead's book by them, and feel interested in the subject, will probably purchase Mr. Smiles' edition.

INCREASE OF WAGES.—On the 14th inst., Mr Sheriff Figgins and his Son, Mr. James Figgins, of Ray-street, Farringdon-road, formerly of West-street, City, letter founders, had an interview with their dressers, and intimated that they would give them an advance of 3s. per week upon their wages, which advance should date from Saturday, the 30th ult. They further proposed some other liberal alterations, which cannot fail to give the greatest satisfaction.

DEATH OF AN EMINENT MINING ENGINEER.—Intelligence reached Newcastle-on-Tyne on Tuesday evening that Mr. Nicholas Wood, of Hetton Hall, the eminent mining engineer, was dead. Mr Wood, who was in the 72nd year of his age, had gone to London to consult his medical adviser, and died there on Tuesday. Mr. Wood had been connected with extensive mining operations in Northumberland and Durham fully half a century. He was associated with George Stephenson at Killingworth Colliery, and had for years been a great authority upon all subjects relating to mining engineering in every part of the kingdom. Mr. Wood was a large coal owner in the county of Durham, and his name is associated with the late Mr. John Buddle and other great authorities in mining engineering, and with George Stephenson in the early history of railways.

EXTRACT OF COGNAC AND OF WINE.

This is a mixture of several ethers of the ethylic series, but of which the special odour is that of pelargonic ether. The essences may be prepared in two ways; the first gives nearly pure pelargonic ether, the other mixture is a very variable composition and apparently inferior in quality. By the first method, pelargonic acid is obtained by treating oil of rue by nitric acid; to etherise pelargonic acid, dissolve it in concentrated alcohol, and pass into the mixture a current of dry hydrochloric acid; the pelargonic ether rises to the surface as it forms. By the second method, a fatty body is treated by nitric acid, and fixed fatty acids are produced, such as adipic, pimelic, lauric, succinic, &c., and also volatile acids, which may be distilled, and of which the chief are butyric, valerianic, capric, caproic, caprylic, œnanthylic, and pelargonic. This is the mixture which is to be etherised. Alcohol is sometimes scented with the product obtained by etherising cocinic acid, extracted from cocoa-nut oil. To obtain this acid, saponify cocoa-nut oil by potash, decompose the soap by hydrochloric acid, dissolve the acid thus obtained in alcohol, and pass into it a current of dry hydrochloric acid; a yellowish liquid will be the result; wash it with water and alkaline water, when pure cocinic ether will remain, which mix with ten times its volume of alcohol. The richness of commercial essences in pure essences may be ascertained by distillation; alcohol boils between 80° and 85°, and the essences remain as residue. Artificial essences are not generally used in perfumery, expecting essence of mirbane; but other agreeably-scented essences will very probably be some day used, carefully combined and considerably diluted. As found in commerce, they have an odour which is far from agreeable, and they, moreover, have an injurious effect on the animal economy when inhaled in sufficient quantity; they must then, if used, be used sparingly.—*Des Odeurs, des Parfums, et des Cosmetiques.*

USE OF ULTRAMARINE IN REFINED SUGAR.—M Monier writes to *Les Mondes* that the use of indigo, referred to in the *Chemical News* same time ago, has long been given up, and ultramarine is now employed. For a boiling of 800 loaves, weighing on the average 10 kilogrammes each, about 40 grammes of ultramarine is sufficient. This quantity, which gives about 6 centigrammes to a loaf, is enough to communicate the very slight blue tint required. Ultramarine is perfectly inoxious.

THE first invention of the process of procuring alum by artificial means is not known, but it appears to have originated in the East soon after the twelfth century. In the fifteenth century there were alum works at Constantinople.

WAGES MOVEMENT IN THE ENGINEERING TRADE.—A meeting of men employed in this trade was held last Tuesday evening, at Wilcocks's-rooms, Westminster-road, for the purpose of considering the best means of obtaining an advance on the present rates of wages. After some discussion, it was resolved that the advance to be asked for should be ten per cent on the present rate of wages. It was also resolved that district meetings should be held throughout London, so that the whole of the trade should be embraced in the movement. A committee was then appointed to carry on the agitation, consisting of delegates from the principal shops in the trade, and subscriptions are to be received from each district to pay the expenses of the movement. The present movement has taken place against the wish of the officials of the society.

We mentioned last week that, at the moment of going to press, we had received a communication from the solicitor of Messrs. Holtzapffel and Co. respecting certain alleged infringements of their copyright in the late Mr. Charles Holtzapffel's work on Turning and Mechanical Manipulation, and at the same time promised a full apology, should we upon examination find that we had been led to any infringement of their rights: we have since made an examination into the circumstances, and deeply regret to find that we have been most seriously misled by a contributor upon whose good faith we implicitly relied, but who has, unfortunately for ourselves, supplied us with extracts from Holtzapffel's "Mechanical Manipulation," in place of original articles as we supposed them to be. Under these circumstances there is but one course that would be followed by any respectable journal, namely, to offer every apology and amends in our power for the infringement which has most assuredly been entirely unintentional upon the part both of the management and proprietors of this journal.

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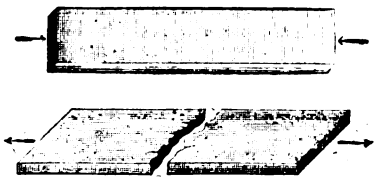
KIRKALDY'S IRON AND STEEL TESTING WORKS.

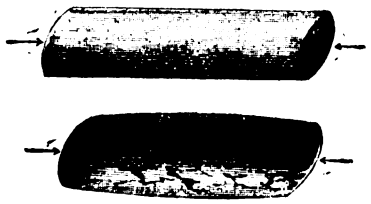
The immense extent to which iron is now employed in buildings of all descriptions in the metropolis, has induced Mr. Kirkaldy, author of the well-known work on iron testing* to erect in The Grove, Southwark, works for testing materials and details. The machinery has been constructed from Mr. Kirkaldy's designs, by Greenwood and Batley, of Leeds, and is adapted for any kind of strain-pulling, crushing, beating, twisting, shearing, punching, bulging, buckling, collapsing, or bursting—well exhibited by our illustrations; and this to any amount, from 10lbs. to 1,000,000 lbs. It will also test specimens of substances as well as manufactured articles; and will, as required, ascertain the ultimate breaking strain or any lowered amount of proof strain. There can be little doubt but that engineers, architects, ship and bridge builders, boiler-makers, and others, will find Mr. Kirkaldy's apparatus advantageous in determining the best proportions in structural details, as well as the materials and variety of materials adapted to their different requirements.

Among the first works subjected to the operation of the apparatus was the patent girder of the Messrs. Phillips, of the Coal Exchange. Of this girder we may remark, in passing, that its peculiarity consists in the flanges being rolled solid, instead of being rivetted, as heretofore, whilst the web is somewhat thicker than usual. In the trials the first experiment was with a light girder, 8 inches deep, with 2½ inch flanges, and 20 ft. between the supports; the weight was 22 lb. per foot run, the iron equal to ordinary Staffordshire plate. The breaking weight of an ordinary similarly sized girder is about four tons. At seven tons the supports of the new girder gave way, and it turned over in the grove of the machine. On examination, though considerable vertical set was found, there was no fracture. Other experiments were equally favourable to the Phillips' girder.

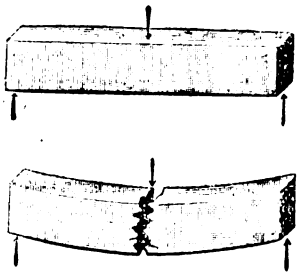
In the illustrations, as noted (the arrows exhibiting the directions of the strain, and the specimens as before and after the strain), Figure 1



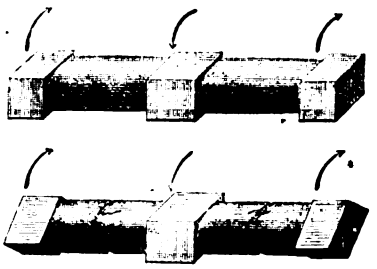
exhibits the tensile strain—or that applied to chain and other links, springs, bars, angle iron, wires of various kinds, up to any length—Fig. 2 exhibits



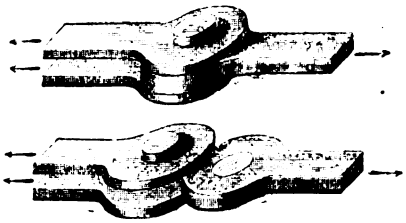
the crushing strain, applied to pillars, walls, &c.; Fig. 3, the bending strain, applied to girders,



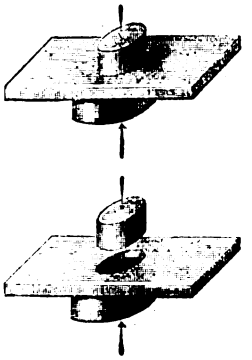
joists, rails, &c.; Fig. 4, the twisting strain, for



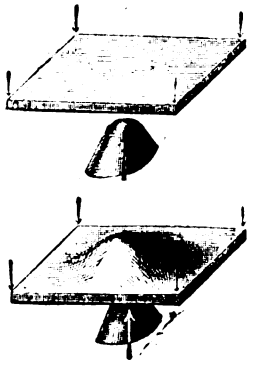
crank axles, and shafting, &c.; Fig. 5, the shearing



strain—sufficiently explained in the figure—as are

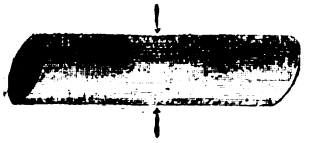


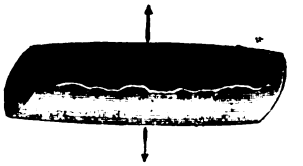
also Fig. 6 (the punching strain), and Fig. 7, that



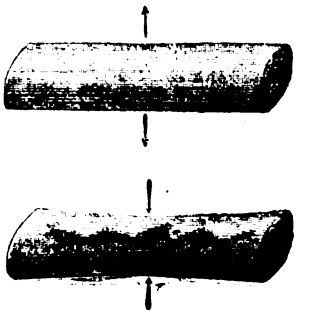
for bulging. Fig. 8 exhibits the buckling strain

as applied to a ship's plate. Fig. 9, the collapsing





strain, applied to boiler tubes or others exposed to external pressure. Fig. 10 represents the effects of



the bursting strain, usually applied to boilers, or to any hollow vessel subjected to internal pressure, as waterpipes, steam pipes, gauges, &c. The apparatus is adopted to many other strains which need not be here specified. We think these illustrations are so self-explanatory as not to require any further elucidation. The contrast between the perfect and imperfect material is exceedingly striking and truthful. We now turn to Mr. Kirkaldy's work itself, having no doubt that the following particulars respecting the properties and management of wrought iron and steel, will be found highly interesting and useful to a great number of our readers. They are extracted from a work written by Mr. David Kirkaldy (above referred to), who carried out an elaborate series of experiments to ascertain the comparative tenacity and other properties of iron and steel.

As Mr. Kirkaldy observes, "It seems remarkable that whilst we have the results of many important and reliable experiments on cast iron, extremely few have been made, or at least published, on wrought iron, and almost none on steel." The conclusions therefore, drawn from the results of his own carefully conducted experiments, which in some instances do not altogether agree with several generally received opinions, will no doubt be acceptable to many who may not have had an opportunity of reading the work. Mr. Kirkaldy's book contains a number of well arranged tables with suitable remarks upon them, and the opinions of many eminent engineers on the points under investigation. Dr. Percy mentions the work in the following terms: "An excellent digest of information published on this subject is contained in Mr. David Kirkaldy's recent valuable work on the tenacity, or, as it is now termed, *tensile strength* of iron and steel;* and the author appears to have arrived at nearly the same conclusions as myself," and further on in a note,† "This excellent work ought to be in the possession of every civil engineer."

The conclusions drawn by Mr. Kirkaldy from the results of his experiments are as follow:—

1. The breaking strain does *not* indicate the quality, as hitherto assumed.
2. A *high* breaking strain may be due to the iron being of superior quality, dense, fine, and moderately soft, or simply to its being very hard and unyielding.
3. A *low* breaking strain may be due to looseness and coarseness in the texture, or to extreme softness, although very close and fine in quality.
4. The contraction of area at fracture, previously overlooked, forms an essential element in estimating the quality of specimens
5. The respective merits of various specimens can be correctly ascertained by comparing the breaking strain *jointly* with the contraction of area.
6. Inferior qualities show a much greater variation in the breaking strain than superior.
7. Greater differences exist between small and large bars in coarse than in fine varieties.
8. The prevailing opinion of a rough bar being stronger than a turned one is erroneous.

* Results of an Experimental Enquiry Into the Comparative Tensile Strength and Other Properties of Various Kinds of Wrought Iron and Steel. London, 1862.

* Metallurgy of Iron and Steel. London, 1864.
† Ibid. note 11, p. 862.

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9. Rolled bars are slightly hardened by being forged down.

10. The breaking strain and contraction of area of iron plates are greater in the direction in which they are rolled than in a transverse direction.

11. A very slight difference exists between specimens from the centre and specimens from the outside of crank-shafts.

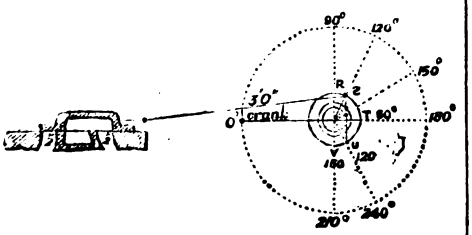
12. The breaking strain and contraction of area are greater in those specimens cut lengthways out of crank-shafts than in those cut crossways.

13. The breaking strain of steel, when taken alone, gives no clue to the real qualities of various kinds of that metal.

(*To be continued.*)

KING, SMITH, & HOWELL'S (HARTFORD STEEL WORKS, SHEFFIELD) PATENT IMPROVEMENTS IN THE REVERSING AND EXPANSIVE WORKING OF STEAM ENGINES.*

The problem of the advantageous use of the steam evaporated by the boiler being almost wholly centred upon the mechanical arrangement used for admitting the steam to the cylinder, it does not seem remarkable that a great amount of attention should have been paid to make so essential a part as perfect as possible, and in no case is this so much exemplified as in the history of the locomotive engine. Upon its first introduction, it was found that the plan then known of shifting an eccentric round upon the shaft, to reverse, was unequal to the requirements of the case in question; and the field being open, many applications were made for the protection of inventions to effect this purpose, but it was not till the year 1839 that anything of a promising nature was produced. In this year Mr. Dodds took out a patent for shifting an eccentric across the shaft by means of a wedge motion; but he does not appear at this time to have been aware that a slight modification in the arrangement would have placed him in possession of a motion theoretically superior to the link motion brought out four years later, and which only required to be worked out into a practical form to make it superior to what has been well called a princely motion. The discoveries of the important qualities of Howe's link as a valuable expansive gear, its superiority above all others, its various forms, and its universal applications in practice, are so well known, that it will be unnecessary to refer to them in the present article, the object of which is briefly to investigate the properties of a stud pin, or single eccentric thrown out of centre and shifted straight across the crank shaft, and then to explain the mechanical arrangement, based upon the principle of differential motion, invented and patented by us for effecting this purpose, both in marine and stationary engines; also to show how a correct exhaust may be given to the steam in the cylinders when the valve is worked by the link, or by any other motion having similar properties.



To avoid as much confusion as possible, we will suppose throughout that the outside lap on the valve is equal to the width of the port, which we will take at 2 inches, but that there is no inside lap; so that when the valve is in the centre of its travel a motion either way will allow the steam to exhaust, and that the maximum travel that can be given to the valve will equal 8 inches.

Diagram 1 represents a valve of the above proportions worked by a stud pin, S, in which the steam is just being admitted to the port, P, the crank, C, being at the dead centre, and the engine running in the direction indicated by the arrow. When S was at R the valve was in the centre, and the lap being equal to 1 inch, or one-fourth the travel of the valve, that distance must be moved through by the valve to open the port previous to the time the crank arrives at its dead centre; this will require S to be placed 120° in advance of the crank. By following the motion of S during the next 60°, when it will have arrived at T, the port will be wide open, after which the valve will begin to close the port, and will have completely closed it when S arrives at U, a point corresponding to S, but on the opposite side of C T, the steam having been admitted to the cylinder during the time that the crank has been running through 120°, or, disregarding the small difference produced by the connecting rod, three-quarter stroke of the piston; by continuing to follow the motion of S till it arrives at V, when the valve is in the centre of its stroke, the exhaust will take place, the crank having moved through 150°, or after nearly 15-16ths of the stroke has been completed, and at the same time the steam will be cushioned on the other side the piston.

If, while the crank is in the position shown, S is moved across the straight line S U, but a very slight motion would be given to the valve, which for all practical purposes might be regarded as nothing. Let S be moved down till it corresponds to a position answering to 180° in advance of the crank, this will shorten the travel of the valve, but the lead will remain the same; the port will then be widest open after 45° and closed again at 90° of movement of crank, which would correspond to one-half stroke of piston, by this alteration cutting the steam of one-quarter stroke earlier than before; but at the same time, the exhaust will take place earlier, or after the crank has passed through 135°, or about 6-7ths of the stroke of the piston. Again, by shifting the stud pin to 175° in advance of the crank, the port will be widest open after 5° and closed again at 10° after the piston had passed through 1-130th of its stroke, but the exhaust will take place a little after one-half stroke.

If the pin, S, is now moved across C T until it arrives at U, and is there fixed, it will be evident that to open the port at all the engine must run in a contrary direction to what it did when S was on the other side C T, and this will be the case when S holds any intermediate position between U and C T. That this will be a similar motion communicated to the link by the action of two eccentrics occupying the extreme positions, S and U, of the stud pin—that is, if the irregularity produced by eccentric rods is neglected—will be apparent when it is considered that the link itself is a vibratory lever, from the ends of which a motion is given to the valve equal in every respect to that produced by the stud pin when in the positions S or U; while in any intermediate position the action of S or U would preponderate in the same ratio as it does when S occupies any correspondingly intermediate position upon the straight line, S U; and by bearing this in mind it is easy to point to the position in the link corresponding to any place that might be selected as the point of cut off, which we shall require to do hereafter.

What effect is produced by the varying angularity of the eccentrics will be shown when we come to make a comparison between the single eccentric and the link motion: but we will now proceed to describe the mechanical contrivance proposed by us for shifting the stud pin, or single eccentric, across the shaft, in large classes of engines where great power is required to move the valves.

Figs. 1, 2, 3, and 4 show different views of an arrangement in which the shifting eccentric is used, and fig. 5 an arrangement where the stud pin is made to answer the same purpose; but the principle employed in both cases being the same, fig. 5 will best answer the purpose of a general explanation, being on an enlarged scale. I is the one end of the crank shaft of an engine, the opposite end of which is supposed to be in connection with the screw or other machinery which the engine may be driving.

Fig. 1.

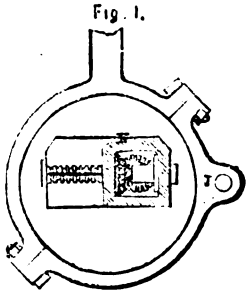


Fig. 2.

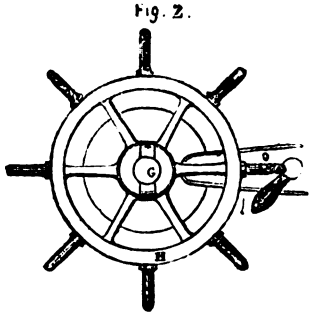


Fig. 3.

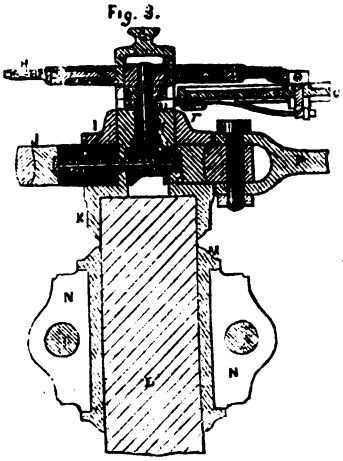
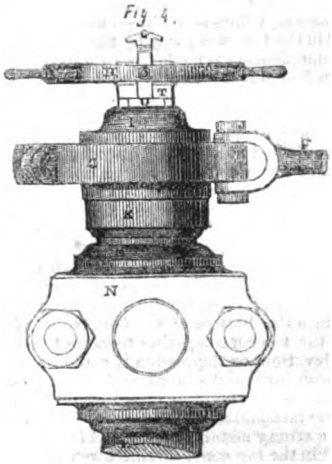


Fig. 4.



Upon the spare end a wrought iron piece, FG, is either bolted or fastened by means of a cottar, and upon this piece is fitted the whole of the improved motion. Through G a slot is cut, into which the sliding piece carrying the stud pin, *s*, is fitted, and which is capable of sliding backwards and forwards upon *g* to such an extent as to allow the stud pin, *i*, to occupy positions corresponding to *s* and *u* (diagram No. 1). The screw, *s*, which is the medium through which the movement is effected, passes through the centre of both the cog wheels, *c* and *d*. *d* has a boss made sufficiently long to pass through F, into which a thread is cut, and through which screw, *s*, passes, answering the duty of a nut; the other wheel, *c*, has a feather, Z, let into it, which fits into a slot shown upon the screw, which will oblige the screw to turn whenever *c* turns. The two wheels, *c* and *d*, gear into *a* and *b*, which are fitted loose upon the shaft, but independently one of the other, which will enable them to be held from turning while F is turning round with the end of the screw shaft. This is done by means of the end of the hand wheel shaft and pinion, F, which are pushed forward, the end of the shaft slipping into the slots in the washer, Y, which will stop *b* from turning; and *a* is prevented from doing the same by

* Communicated by Mr. HENRY J. H. KING, Mechanical Engineer, to the *Practical Mechanic's Journal* for December.

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the pinion, F, which gears into it. The two pair of wheels, *a* and *c*, and *b* and *d*, bear the same ratio one to the other; and *a* and *b* being fixed, *c* and *d* will make an equal number of revolutions, giving us the case of a nut upon a screw turning at an uniform rate; and while they remain as they are, the stud pin will remain in an unaltered position. But if we now want the point of cut off to be varied, or the engine reversed, we have only to turn the hand wheel, H, which will turn *a*, whilst *b* remains stationary, producing a differential motion upon *c* and *d*, and making the nut wheel either run faster or slower than the screw wheel, and a transverse motion will accordingly be produced, shifting the stud pin, if continued long enough, to the other side the centre of the shaft, and reversing the engine.

(*To be continued.*)

THE FEED APPARATUS OF BOILERS.

The Giffard Injector which has been sought to be applied to the purpose of filling or supplying locomotive and other boilers with water has travelled a thorny path since the time of its discovery. This is no doubt owing to the great mystery which has seemed to be associated with the instrument itself. It is at first sight paradoxical that steam issuing from the steam space of a boiler can retain sufficient force to force water into the bottom of the same boiler from which the steam is issuing to perform the work. This fact has had a sort of perpetual-motion look about it which has seriously operated against a proper investigation of the real qualities of the injector. But it results upon examination that, not only may this be the case, but that a donkey engine working at 30lb. may force a supply of water into a boiler which is giving off steam at 60lb., and consequently affording this resistance to the entry of the supply of water. The operation of pumps in connexion with steam apparatus is a matter of continual anxiety. This is the case even with stationary as well as with locomotive engines, but it seems that pumps are inseparable from the system of marine locomotion. Owing to the unequal and sometimes sudden motions of a vessel at sea, the operation of the injector, its direction, and velocity, are affected. All that is necessary therefore is to enclose this, and give it some particular direction, which is into the boiler. This is accomplished in the following way by the Giffard Injector. A communication is made from a water supply not more than 5 or 6 feet beneath the boiler to the injector. The injector is practically two tubes of about 6 or 12 inches each in length, their diameters at one end being larger than at the other, their smaller diameters are adjusted at a trifling distance apart, so that a current of water could play from one into the other. The upper tube is called the combining cone, and the lower the receiving cone The water is allowed to flow round the locality at which they are separated, and may be supposed to have a level two inches up the combining or top cone through which the steam passes to force the water through the aperture of the lower cone, and so on, by a conducting pipe into the bottom of the boiler A plug is inserted in the top cone tapering towards the end, so that by elevation or depression it could entirely control the steam force and water supply by stopping up the aperature of the top cone at its lower diameter; these mechanical conditions are of course protected by a strong metallic casing. The steam is then admitted in the top cone, forcing away the residuary water is interfered with, the current of the water supply being continually broken like the breaking of a current of electricity. But in the working of land engines, where the pump is a source of perpetual annoyance, it appears unquestionable that the injector could be applied with considerable advantage. It is well known that in the locomotive system the repair of pumps alone forms a large item in the cost of working, besides the continual and anxious watching they require while in operation. But in the case of an injector attached to a boiler it may be so regulated that no excess or want of water can take place. Applied to a good working boiler and engine the injector seems to represent that one function which confers upon an inanimate and material system of motion the same qualities as though they had proceeded from some living organization.

The great objection which appears to stand in the way of its general adoption is that of the so-called mystery of its operation. In the way of illustration, if it could be supposed that a common hour glass could act as well horizontally as it does vertically we would reach in a certain measure an ocular proof of injection. In the steam injector, the velocity of steam passing over a tube standing upright in water would from sympathy cause the water to ascend the tube, and a small quantity of it to partake of causing a vacuum in the supply pipe leading to the source of the water, owing to the great velocity at which it escapes at an outlet provided for the purpose of setting the injector in motion. The water then rises up the tube, and finds a direction towards the point where the two cones are separated, where the steam acts upon it, forcing it into the underneath cone, and away on into the boiler.

LENOIR'S GAS ENGINE

Dr. Grace Calvert, in the second Canton Lecture, at the Society of Arts, on some of the most important chemical discoveries of the last two years, thus speaks of Lenoir's Gas Engine:—"It is the production of motive power through the combustion of coal gas, and you will, I hope, appreciate the discovery due to M. Lenoir if you call back to memory the efforts which have been made for the last twenty or thirty years to generate power by employing the expansion which air or other gases undergo under the influence of heat, as a substitute for steam—the long-promised success and the unfortunate failures of Ericsson. What specially recommends the engines of M. Lenoir is their safety, for there is no danger of explosion; their cleanliness, for they require no fuel; their simplicity, which enables those who employ them to use them in any room, at any height, and at any spot where motive power may be required; for they have only to erect a little engine of one or two horse power, and whenever they require to use it, all they have to do is simply to bring into contact two poles of a battery, when the fluid so generated will traverse space, and convey motive power to the gas-engine. Lastly, these engines are extremely economical in their working, for they consume only 70 feet of gas per horse power per hour; and assuming that 1,000 feet of gas is worth 4s. 6d., the cost of working an engine of one-horse power will be about 4d. per hour. M. Lenoir's engine is very similar to the ordinary steam-engine, having a cylinder, piston, crank-shaft, and fly-wheel The following proportions of gas are admitted in the cylinder:—One volume of gas (coal gas) mixed with twelve volumes of atmospheric air. This mixture is ignited by the electrical spark from a battery connected by wires at each end of the cylinder. The connexion being made and broken by the rotatory action of the crank-shank, the expansive force necessary to move the piston of the engine is produced by the ignition of the gas, which not only produces steam and carbonic acid by their combustion, but by the heat generated increases their volume to a sufficient extent to force the piston to travel backwards and forwards, thus producing motion The engine once fixed, the battery charged, and the gas turned on, it is ready for action, and as the work required is completed the gas is shut off, the engine stops, and the expense ceases. The facility for employing Lenoir's engine in countries where coal is not easily attainable has been increased by substituting for coal gas a mixture of oxide of carbon and hydrogen, which can easily be procured on a commercial scale, at a small cost, by passing steam over heated charcoal, the water being decomposed, its hydrogen being liberated, and its oxygen combining with the carbon, itself produces oxide of carbon, and the mixture of these gases is a cheap and good substitute for coal gas. Consequently, M. Lenoir's engines can be employed with great advantage in our British colonies and in South America.

A CHRISTMAS OFFERING TO THE JUNIOR READERS OF THE ENGLISH MECHANIC.

Sir,—Knowing, as I do, that your valuable paper is welcomed with gladness by a great number of youthful students in science, I hope I shall not be intruding in vain if, on this occasion, I address myself solely to them.

My young friends,—I am not just now about to make a discursive flight among the deep mysteries of science, but wish to confine myself to that portion wherein you may not only understand me, but be able to construct apparatus and try the experiments for yourselves.

Human beings in the abstract are pretty much alike, and I assure you I have felt infinitely more pleasure when witnessing the successful result of some simple experiment made by myself at my own fireside than I have derived from seeing the same result on a stupendous scale, where I only saw while another was the performer.

Give Archimedes his lever and fulcrum, and let him move the world; what then? He knows no more of the value of the lever than you or I, if equally acquainted with the principle of its action, when we remove a stone block one inch at a time nearer to its ultimate destination with a crowbar.

It is not, my young friends, what we could do if we had the means, but what we *do* with the means we have that either makes us great in the world or do greatly for the world in our day and generation.

It is my intention on this occasion to treat of the chemistry of the gases, so far as that subject will serve as a pleasing and interesting subject for your study during this holiday season. We live at the bottom of an ocean of atmospheric air, composed of oxygen and nitrogen gases in a state of mechanical mixture, in the proportion of about one-fifth of the former to four-fifths of the latter, and it is a strange fact that science has revealed to us that wherever the air has been taken from these proportions hold good. "Air has been brought from lofty Alpine heights, and compared with that from the plains of Egypt; it has been brought from an elevation of 21,000 feet by the aid of a balloon; it has been collected and examined in London, Paris, and many other districts; and still, such is the wonderfully diffusive power of gases, the proportions of oxygen and nitrogen have been found the same." Here, then, in every breath we draw, if properly examined, we have direct evidence of the power, wisdom, and beneficence of the Creator. Oxygen is the great supporter of animal life, nitrogen its deadly enemy, and the same may be said of all kinds of artificial combustion. If the atmosphere were all oxygen we should just live too fast, or, which is the same thing, "burn out" too rapidly. If it were all nitrogen we should die at once, for though as far as we know of it, nitrogen does not kill people, yet for a certainty it will not let them live, so it comes to the same thing in the long run.

This effect of nitrogen is exhibited when we apply an extinguisher to a candle, or a damper on the top of a furnace chimney, closing the furnace doors; and if we float a small piece of phosphorus, or a piece of cork in a basin of water, by igniting the phosphorus and quickly inverting a tumbler over it, we remove all the oxygen, replacing it by phosphoric acid, which is rapidly absorbed by the water, the latter rising in the tumbler to the height due to the quantity of oxygen removed.

The atmosphere is at all times contaminated with other gases, some of which are very poisonous, such as sulphuretted hydrogen and carbonic oxide.

The former of these it obtains generally from stagnant pools, and some from the combustion of ordinary coal fires, and the delightful aroma due to its presence even in very small quantities may be known to any who have had the pleasure of smelling a putrid egg. The latter (carbonic oxide) is the deadly gas which kills people who descend into wells, and is better known as the "fire-damp," which destroys so many of our coal miners who have chanced to escape from an explosion of carburretted hydrogen.

The sins of this deadly gas were for many years heaped upon the head of "carbonic acid," one of the most innocent of the gaseous family; in fact, it is to carbonic acid that we are indebted for aerated bread in lieu of the heavy indigestible baked dough, for fine sparkling ale instead of ale "flat, stale, and unprofitable." To this gas the cooling effervescence of lemonade and champagne are due, and we are much indebted to science for removing from the shoulders of this innocuous, jolly, good-natured gas the foul anathemas due to his younger brother.

To speak metaphorically, "acid," the elder brother, has two atoms of oxygen, while "oxide," the younger, has only one, in consequence of which he goes roaming about a perfect misanthrope, ever ready to rob anything or anyone, so that he may arrive at the same status as his senior. Well! a human victim goes down a well; "oxide" is there and on the alert. The moment the victim opens his lips for an inspiration, down rushes "oxide," and instead of giving robs the poor victim's lungs of this much-coveted oxygen and escapes; but the heart is at work, and forces the unoxygenated blood to the brain, when the victim instantly falls senseless, for the brain cannot perform its functions in the absence of oxygen, and upon its action depends those of the whole vital system. Thus "oxide" succeeds, but the victim is a corpse!

In order to study the nature and effects of gases, the apparatus required are few, simple, and not costly, if we go the right way to work; and it is in this respect I trust to make myself more especially useful to my young friends. First, then, obtain from any oil shop a few Florence flasks (price one penny each); wash them well in a strong solution of common soda and water Procure a spirit lamp (cost one shilling and the methylated spirit sixpence per pint), a few glass tubes ¼-inch diameter (cost eighteenpence per lb.), a foot of india rubber tube (cost threepence), to serve as joints for the glass tubes; a glass jar similar to those in which sweetmeats are generally kept, about 8″ deep by 4″ diameter (cost eightpence), with a wood cover loosely fitted, this having a hole about 1″ diameter through

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its centre, and a small glass tube passed through reaching nearly to the bottom of the jar, and protruding about one inch, as shown in Fig. 1. Lastly,

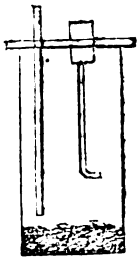

FIG. 1.

obtain a common tin saucepan (cost 1s.) Take the handle off the lid, and solder up one of the holes you thereby make, while in the other enlarged, as shown at Fig. 2, you solder in a short bent pipe ¼" dia-

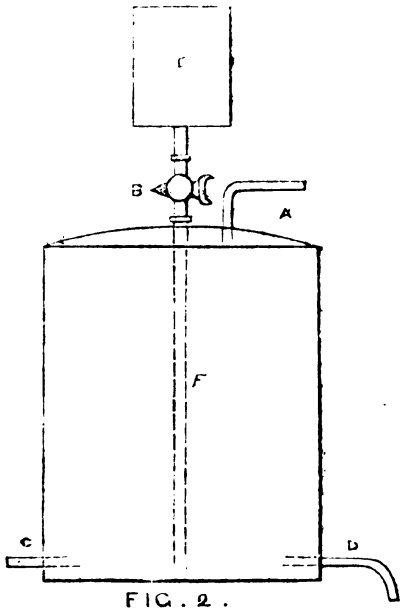

FIG. 2.

meter made of brass, ¼" tube (threepence per foot); *b* is a ¼" gas-cock (price ninepence), having a tube *f*, tinned to it, and also to the saucepan lid in the centre; this passes nearly to the bottom of the saucepan when the lid is fixed; a short tube connects the top of the cock to a small cylindrical reservoir, which can readily be made of a coffee canister cut in two with a file. Again, near the bottom as possible, on each side solder in two other brass tubes, *c* and *d*, and having soldered the lid securely to the saucepan, you have at once a very efficient gasholder.

To use this we put a small cork in each of the tubes *c* and *d*, leaving *a* open, and pour in water till the gasholder is filled, when the water will run out at *a*. Turn off the cock *b*, put a cork in *a*, and then open *c* and *d*. If now we attach any source from which we are generating gas to *c* by the india-rubber tube, the gas, by its superior levity, will rise through and displace a quantity of water equal to its own bulk, such water passing out at *d*, and this will continue so long as the gas is generated until the gasholder is filled, then disconnect the generating apparatus, and cork up both apertures, *c* and *d*. To use the gas thus stored we have only to attach a bladder, or any other receiver to *a*, fill the reservoir *e* (and keep it full), with water, which by its superior gravity will descend the tube *f*, and force out the gas through *a*. This holder is most useful in experiments with oxygen and hydrogen, but the latter gas should never be left in the holder after it is done with, as it may form an explosive mixture, from which by inadvertence most disastrous results might ensue Oxygen for experimental purposes is most readily obtained by mixing powdered chlorate of potash (sixpence per oz.) with a small quantity of black oxide of manganese (twopence per oz.) Half an ounce of chlorate should yield nearly one gallon of pure oxygen, while the manganese, being unaltered by the operation, will serve again for future experiments. The mixture is introduced into one of the Florence flasks, and the temperature raised by the spirit lamp. When at a dull red heat the oxygen is given off, which may readily be ascertained by holding a piece of ignited charcoal at the extremity of the tube coming from the flask, the brilliant glow which it assumes showing the presence of free oxygen. So soon as this takes place couple up the conducting pipe to the pipe *c* of the gasholder, and fill it with the gas,

I need not enumerate all the beautiful experiments that can be made with this gas in its pure state, but may intimate to the uninitiated that all of them can be performed in the glass jar abovementioned (Fig. 1) by simple displacement, in consequence of the superior gravity of oxygen over atmospheric air; but in all cases where metallic wires are burned, the bottom of the jar should be covered about 1" deep with silver sand, as I have found water an insufficient protection from the intense heat of the burning globules thrown off.

Judging from my own experience, I should say that no experiment within the range of chemical science, neither excepting the electric, the lime, nor the magnesium lights, can compare with the combustion (in a jar of pure oxygen of the given dimensions) of a few grains of carefully dried phosphorus.

And now for Hydrogen. There was a time within my memory when scientific books to persons in my capacity were about as accessible as the heights of Mount Blanc.

Well do I remember spoiling my mother's scissors outting up zinc sheet, and when this failed rasping away at a block of the metal to reduce it to the tenuity then considered necessary for the production of hydrogen. What hours of useful labour might I not have saved if "Statham Cabinet" had then been on sale, and his "First Steps in Chemistry" published to the world! but, alas, it was not so, and therefore I and no doubt many more went filing and cutting on till somebody told them and me that zinc by being melted in a laddle and poured into cold water from a height of five or six feet assumed just the attenuated form that was requisite for its use in the production of hydrogen.

This is very readily accomplished by obtaining a wide mouthed pickle-bottle (value one penny), well corked and covered with sealing wax varnish, two holes are perforated in the cork into which two pieces of glass tube are inserted, one reaching nearly to the bottom, the other just passing inside the cork. The one which goes near the bottom is formed into a funnel by a piece of sheet gutta-percha, and through this, from time to time, as may be found necessary, small quantites of sulphuric acid are poured upon the granulated zinc and water with which the bottle is first charged.

The other tube forms the outlet for the generated hydrogen, and after the first impure portions are allowed to escape this must be coupled up to the gasholder the same as in the case of oxygen, and the gas collected in the same manner, and thence again driven off into bladders for use in experiments With these two gases *separately* stored a variety of interesting and instructive experiments may be performed. Thus if a strong glass bottle is filled with them in the proportions in which they unite to form water, and the mouth of the bottle be made to approach a lighted taper a sharp ringing explosion takes place, and a very small quantity of water is produced A similar thing can be done on a smaller scale by forming bubbles of the combined gases on the surface of a strong mixture of soap and water, taking the precaution to remove the pipe connected with the bladder clear away from the soap water before the bubbles are ignited. Mixed in this proportion these gases produce a solid flame of greater intensity than any other known artificial combustion, the metals are rapidly volatilized under its action, and nothing except magnesia and lime have been found to withstand its effects, while the latter is raised to so high a degree of incandescence as to produce that beautiful phenomenon called the "lime light."

Carbonic acid is generally prepared by using a vessel similar in every respect to that described for hydrogen, substituting white marble or common chalk for the zinc, and hydrochlorine acid as the decomposing agent. It can be collected for experiment by displacement in the jar described above, being very considerably heavier than atmospheric air. One of the most interesting experiments with the gas is to place a lighted taper in the bottom of any glass vessel, and then pour the carbonic acid on it, as if it were so much water, the gas sinks by its density, and when it comes in contact with the light extinguishes it as surely as so much water would do.

A variety of other experiments might be detailed, but I fear I have already trespassed too far upon your space, and will therefore conclude with one experiment, wherein a variety of gases are called upon at once to play a part, and which may be called a Pyrotechnic Pudding. Pound in a mortar, separately, one ounce of chlorate of potash, and two ounces of loaf sugar, then mix them intimately with the fingers on a sheet of paper, place them when mixed in the middle of a large plate, piled up in the form of a cone, and having previously dipped a glass rod in strong sulphuric acid, desire some novice to mix the pudding up with it, upon his trying to do so a vivid conflagration will ensue, to his amazement and the amusement of all, the pudding vanishing without leaving a plum behind WM. TONKES.

IMPORTANCE OF KNOWLEDGE TO THE MECHANIC.

Let us imagine, for a moment, the condition of an individual who has not advanced beyond the merest elements of knowledge, who understands nothing of the principles even of his own art, and inquire what change will be wrought in his feelings, his hopes, and happiness, in all that makes up the character, by the gradual inpouring of knowledge. He has now the capacity of thought, but it is a barren faculty, never nourished by the food of the mind, and never rising above the poor objects of sense. Labour and rest, the hope of mere animal enjoyment, or the fear of want, the care of providing covering and food, make up the whole sum of his existence.

Such a man may be industrious, but he cannot love labour, for it is not relieved by the excitement of improving, or changing, the processes of his art, not cheered by the hope of a better condition. When released from labour, he does not rejoice, for mere idleness is not enjoyment; and he has no book, no lesson of science, no play of the mind, no interesting pursuit to give a zest to the hour of leisure.

Home has few attractions for him; he has little taste for the quiet, the social converse and exchange of feeling and thought, the innocent enjoyments that ought to dwell there. Society has little to interest him, for he has no sympathy for the pleasures and or pursuits, the cares or the troubles of others, to whom he cannot feel nor preceive his bonds of relationship.

All of life is but a poor boon for such a man; and happy for himself and for mankind if the few ties that hold him to this negative existence be not broken. Happy for him if that best and surest friend of man, that messenger of good news from Heaven to the poorest wretch on earth, religion, bringing the fear of God, appear to save him. Without her to support, should temptation assail him, what an easy victim would he fall to vice or crime! How little would be necessary to overturn his ill-balanced principles, and throw him grovelling in intemperance, or send him abroad, on the ocean, or the highway, an enemy to himself and his kind!

But let the light of science fall upon that man; open to him the fountain of knowledge; let a few principles of philosophy enter his mind, and awaken the dormant power of thought; he begins to look upon his art with an altered eye. It ceases to be a dark mechanical process, which he cannot understand; he regards it as an object of inquiry, and begins to penetrate the reasons, and acquire a new mastery over his own instruments. He finds other and better modes of doing what he had done before blindly and without interest, a thousand times. He learns to profit by the experience of others, and ventures upon untried paths.

Difficulties, which before would have stopped him at the outset, receive a ready solution from some luminous principle of science. He gains new knowledge and new skill, and can improve the quality of his manufacture, while he shortens the process and diminishes his own labour.

Then labour becomes sweet to him; it is accompanied by the consciousness of increasing power; it is leading him forward to a higher place among his fellow-men. Relaxation, too, is sweet to him, as it enables him to add to his intellectual stores, and to mature, by undisturbed meditation, the plans and conceptions of the hour of labour.

His home has acquired a new charm; for he has become a man of thought, and feels and enjoys the peace and seclusion of that sacred retreat; and he carries thither the honest complacency which is the companion of well-earned success. There, too, bright visions of the future sphere open upon him, and excite a kindly feeling towards those who are to share in his prosperity.

Thus his mind and heart expand together. He has become an intelligent being; and, while he has learned to esteem himself, he has also learned to

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live no longer for himself alone. Society opens, like a new world, to him; he looks upon his fellow-creatures with interest and sympathy, and feels that he has a place in their affections and respect. Temptations assail him in vain.

He is armed by high and pure thoughts. He takes a wider view of his relations with the beings about and above him. He welcomes every generous virtue that adorns and dignifies the human character; he delights in the exercise of reason; he glories in the consciousness and the hope of immortality.

G. B. EMERSON.

ELECTROTYPING.

You say you will be happy to receive a mite from those who will contribute to your Christmas number. I will contribute mine by your permission in the shape of instructions in the beautiful art of copying medals, &c., by means of the simple process of electrotyping.

First. I intend to give only instructions for a first attempt. Commence by obtaining a small flower-pot, stop the hole at bottom with a cork, this is the porous cell. next a large jelly-pot. Now proceed to the chemist's and purchase some sulphate of copper, about sixpence a pound, also some sulphuric acid, which is very cheap. You will also require a piece of amalgamated zinc, and a pennyworth of copper wire.

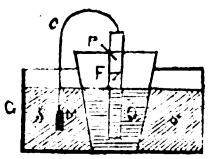
Second. Make a saturated solution of copper in jelly-pot.

Third. In porous cell (flower-pot) put a mixture of 24 parts water, and one sulphuric acid. Take care one solution is equal in height to the other.

Fourth. In your zinc plate make a hole in which insert a piece of copper wire, also make a hole about an inch from top, through which a piece of wood must be passed to support on porous cell.

Fifth. Moulds: these should be made beforehand; make them of gutta percha, warm it in water, which will render it soft, press on a coin, and subject the two to pressure of some heavy books, or better a press. When dry and hard, it must be blackleaded over the face (mind no blacklead does not touch the sides or back, wherever blacklead is, copper is deposited), warm the wire attached to zinc, and stick it firmly on back.

Sixth, and conclusion. Place flower-pot with the acid mixture in jelly-pot with the copper one, plunge your zinc plate into the flower-pot, and allow the mould to hang over attached to the wire. In about twenty-four hours the deposit will be as thick as a cord, you may then remove it. I think the following diagram will make it plainer than description:—



S, S, sulphate of copper solution, A, sulphuric acid ditto, Z, plate of amalgamated zinc, C, copper wire attached to zinc plate, M, G, P, mould, flower-pot or porous cell, G, jelly-pot, P, peg to support zinc on edges of flower-pot.

Saturated means that as much sulphate has been dissolved in the water as it will take up.

Amalgamated zinc plates are made as follow:—Clean a common plate of zinc by dipping into sulphuric acid, place the plate in a shallow dish containing a little dilute sulphuric acid, pour a small quantity of mercury on it, and with a piece of rag tied round the end of a stick rub the mercury over the surface, keeping the rag well wetted with the acid. A small piece of zinc is sometimes useful to collect the mercury from the dish and place it on the plate.

ED. MCGURK.

A SIMPLE FORM OF FILTER.—A very simple and perfect form of filter has been devised by the *apparateur* of the College of France, and deserves attention. It is made by placing in a tank, containing impure water, a vessel in such a position that a sponge which it contains laps over its edge, and dips into the water of the tank. The sponge gradually sucks up and purifies the water in the tank, and allows it to drop into the smaller vessel or receiver, from which it may be drawn off by a tube. By placing a few pieces of charcoal in the bottom of the receiver, filtration of the most perfect kind is effected.

CHEMISTRY.

Mr. W. F. Barrett, of the Royal Institution Laboratory, has communicated to the *Philosophical Magazine* an account of some physical effects produced by the contact of a hydrogen flame with various bodies. When conducting experiments for Professor Tyndall, on the nature of the radiation emitted by various solids heated by means of a hydrogen flame, Mr. Barrett perceived a deep blue colour to arise on the surface of several of the substances examined, as soon as the flame came into actual contact with the body. Careful examination of this coloration showed that the colour was restricted to the place where the hydrogen was in combustion, giving in section an image of construction of the flame. The blueness was proved to be due to no foreign element in the gas. It appeared on various substances, taken at random, such as pieces of granite, metal tubing, but not on all substances; and a classification of the substances experimented upon, according to the effects produced, led to no information as to the cause. Mr. Barrett then imagined it to be a new kind of fluorescence, differing from that discovered by Professor Stokes. An experiment revealed the source of the phenomenon, and succeeding trials proved that it was entirely due to the combustion of sulphur deposited on the surface of the body. An oldblock of granite, when the hydrogen flame was applied, showed the blue colour vividly on every part; but, when the block was split and the flame was brought into contact with the newly-fractured surfaces, not the faintest trace of colour was seen. These experiments show that among foreign ingredients in our atmosphere sulphur, either free or in a state of combination, occupies an important place—probably derived from our coal fires. Mr. Barrett's paper described other phenomena connected with the combustion of hydrogen.

In the new number of the *Journal of the Chemical Society* is a paper, by Dr. David Price, on the action of light upon sulphide of lead, which has an important bearing upon the preservation of paintings in picture-galleries. His attention was directed to this action of light by observing that, in glass cases which are painted with white lead, sulphurous vapours from the substances inclosed did not darken the surface of the case, except where it was protected from the direct influence of light. This fact he verified by experiments, which corroborated the statements respecting the injury which pictures suffer by being kept in ill-ventilated and badly-lighted places, and the beneficial effects frequently resulting from the exposure to light of injured pictures. Sir Charles Eastlake, in reference to Turner's "Queen Mab" and "The Deluge," where the whites are turned to blacks, has stated that white lead, if not tolerably well secured from the effects of the atmosphere, will undergo a rapid change in London. As an illustration, to show that the changes effected by the secret and chemical process may be brought about by simple exposure to light, Dr. Price placed a picture in an atmosphere of sulphide of hydrogen gas until it had acquired a dark brown colour. Strips of paper were then fastened across parts of the surface, and it was placed in a window facing the light. Those portions not obscured resumed their original appearance, whilst those covered with the paper remained black. Mr. Cooke, R.A., also has especially remarked the beneficial action of strong light on his own pictures. This number of the journal also contains Mr. F. A. Abel's "Notes on Some Compounds of Copper and Phosphorus," being the results of experiments made with the view of ascertaining whether phosphorised copper might not be advantageously employed as a material for ordnance.

A MINT for the coinage of Welsh silver was established previous to the reign of Charles I., at Aberystwith. The indenture was granted to Thomas Bushel for the coinage of half-crowns, shillings, sixpences, twopences, and pennies, all of which were to be stamped with the ostrich feathers on both sides.

THE English silver penny of Edward III. was ordered to weigh thirty-two wheat grains of the middle of the ear; twenty of these pennies were to weigh an ounce, and twelve ounces a pound; eight pounds were to be equivalent in weight to a gallon of wine, eight such gallons to a bushel of wheat, and eight bushels a quarter.

WERE Jupiter to fall into the sun it would evolve by the shock as much heat as the sun would give in 32,240 years; and were its rotation stopped by means of a brake, the heat of rotation would be equal to the solar emission for a period of 14 years, 144 days. Were the sun itself stopped in the same manner, the emission of heat would equal 116 years, 6 days expenditure.

SELF-MADE MEN.

Inigo Jones, the architect, was originally a joiner, and Professor Lee, the great Oriental scholar, was a common carpenter. He was first attracted to the study of the Hebrew language by finding a Hebrew Bible in a synagogue while he was engaged in repairing the benches. A desire to read the book in the original seized him, and buying a cheap second-hand grammar he set to work and soon learnt the language for himself.

The life of this same Dr. Lee affords one of the most remarkable instances in modern times of the power of perseverance and resolute purpose in overcoming apparently insuperable difficulties. He received some little education at a charity school, but the master pronounced him to be the dullest boy he had ever known. During his apprenticeship he took to reading to occupy his leisure hours. He mastered several difficult languages; but at twenty-eight years of age, his character as a tradesman being excellent, he married, and, determining to renounce the luxury of book-learning, he sold all his books. By-and-bye a fire consumed his tools, and destitution stared him in the face. Being too poor to buy new tools, he resolved to turn village schoolmaster; but, though master of many languages, he found himself defective in the common branches of knowledge. He set to work, and soon sufficiently mastered writing and arithmetic as to be able to teach them to little children. He then got an appointment as master of a charity school, and was introduced to a very distinguished Oriental scholar. Quietly and resolutely he pursued his studies, acquiring greater and greater proficiency, till at length, by the kindness of a patron, he was enabled to enter Queen's College, Cambridge. Here, after a distinguished course of study, he was at length elected to fill the honourable office of Professor of Arabic and Hebrew. Such, in brief, were the efforts, the perseverance, and the success of Dr. Samuel Lee; an inspiring example, showing what may be done by the humblest man if he will only boldly and perseveringly try.

From the class of day labourers sprang Captain Cook, the eminent navigator—a most enterprising and heroic voyager, who

> "Steer'd Britain's oak into a world unknown,
> And in his country's glory sought his own."

From the barber's shop rose Sir Richard Arkwright, the inventor of the spinning-jenny, and the forerunner of the cotton manufacture of Great Britain; Lord Tenterden, the most distinguished of Lord Chief Justices; and the great landscape painter, Turner. In fact, hardly any craft or trade can be mentioned which has not supplied its instance of persevering effort, in the midst of discouragement and difficulty, at length crowned with honour and success; and it is the glory of our country that such instances should be so familiar and so numerous.—*Old Jonathan.*

The wood of trees which have grown on mountains, under the same conditions, is more compact than that grown in plains; the wood of closely-grown trees is more compact than that of isolated trees; and the compactness appears to increase in proportion to the dryness of the soil.

SUCCESSFUL TRIAL OF GUN COTTON.—A most satisfactory trial of gun cotton has just been made under the supervision of Messrs. Prentice and Revige, with a view of testing the comparative efficiency of gunpowder and gun cotton, when used upon a large scale, for it should be mentioned that Baron Lenk's cotton (of which Messrs, Prentice and Co., of Stowmarket, are the sole manufacturers in England) is already extensively used for blasting operations in many of the collieries of Northumberland and Durham. Where the experiment took place the rock is 34 ft. in height. A drift measuring 2 ft. 8 in. in diameter was driven 30 ft. in a direct line from the face, and from the extremity of these two cross-heads, each of 30 ft., were put out. At each extreme end of these three barrels of compressed cotton were placed, each containing 120 lbs. of explosive material (the 720 lbs. of gun cotton thus put in were considered equivalent to nearly 1 ton of gunpowder), and being provided with two of Abel's fuses to ignite them with, the drifts being properly tamped, the electricity was communicated to the charge from an ebonite frictional battery, and the effect was magnificent. An enormous fissure, 125 ft. long and more than 50 ft. wide, as well as many others of a less extensive character, were produced. It is estimated that fully 15,000 tons of ground must have been dislodged.

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PROGRESS OF INVENTION.

IMPROVEMENTS IN FURNACES.—According to the invention of Messrs. Woodward, of the Queen's Foundry, New Islington, Manchester, it is proposed to supply air to furnaces for melting metals, or smelting ores, by applying one or more jets of steam in the flue, funnel, or chimney leading from the furnace, so as to create a partial vacuum above the fire, the required air to support combustion entering at proper orifices arranged at the lower part of the furnace. The second part of the invention consists in the construction of furnaces for melting metals, so as to apply the waste heat to generate the steam to create the vacuum.

PUMPS.—According to the invention of Mr. J. H. Wilson, of Liverpool, it is proposed that, in the case of a main pump, to cast the working-barrel parallel to a chamber divided internally by a vertical diaphragm, extending nearly to the top. One side of the chamber is connected at the bottom with the head of the suction-pipe, and the other is provided with a port, opening into the working-barrel below the foot-valve. The object of this chamber appears to be to catch any chips or other obstructions which may be pumped up, and which would otherwise pass into and choke the working-barrel.

LINING PUDDLING FURNACES.—The essence of the invention for this purpose, patented by Mr. Robert Mushet, of Cheltenham, consists in employing the compound ore of titanium and iron, ilmenite, when pulverised and mixed with refractory substances, such as lime, silica, kaolin, calcined iron, slag, magnetic iron ore, or hematite iron ore, with or without the addition of salt or other alkaline matter in making, lining, or fettling the sides or bottoms of furnaces used in the manufacture of iron and steel, in order to render them more durable than usual.

MANUFACTURE OF STEEL.—Julien Derry, New York, Alex. Frippel, Brooklyn, and Eugene Gaussion, Baltimore, claim the tuyeres passing through the walls of an arch, and carrying steam to the liquid pig after it has left the furnace, so as to produce granulation.—2. The water tank or reservoir placed under the said arch, for the purpose of receiving and chilling the granulated pig.—3. The tuyeres adapted to the furnace, for the purpose of carrying steam to the re-heated granular pig, with a view to transform it into magnetic oxide.—4. They further and especially claim the general disposition of the appliances for the production of the said granulated, chilled, and oxidised iron.

NEW SUGAR MACHINE.—The *Bulletin Commercial* gives the following particulars of a vacuum machine, invented by MM, Cail et Cie, which has been used with success in Mauritius by M. Portal, owner of the Anse Jonchee estate. The apparatus consists of three vertical cylinders of copper, each containing two tubes half the internal height of the cylinders in which the steam circulates. The cylinders are six feet high and three feet in diameter, and are surrounded by a wood casing, which materially retards the loss of heat; they communicate with the outside by pipes. The first cylinder receives the waste steam, which had hitherto been entirely lost, from the defecators and other machines used in the factory. The steam which rises from the boiling liquid in the first, warms the liquid contained in the second cylinder, and the steam from the second in its turn warms the third; a successive diminution of atmospheric pressure in each cylinder takes place, and this reduction allows an active ebullition to go on notwithstanding the diminution in heat. Two men suffice to look after the apparatus, and if the vacuum pan be conveniently placed, those who are occupied with it can also attend to the cylindrical generators. By this arrangement all the men employed in looking after the coppers, and the furnace which warms them, are rendered unnecessary, and the sugar is prepared at a temperature which renders the formation of molasses impossible. The quantity of crystallisable sugar given by the juice thus becomes considerably greater, and at the same time its quality is said to be so superior that it hardly requires to be washed in the centrifugal machine. The simplicity of the apparatus is such that M. Portal finds that an ordinarily intelligent Indian can take charge of it after a few hours' training, and the only thing required for success is great cleanliness. It works with such rapidity that the cane-juice crystallises in two to two and a-half hours. The saving of fuel by this system is said to amount to one-third.

THE MATERIAL MARKETS.

METALS &c.

		£	s.	d.		£	s.	d.	pr ct.
IRON:—									
Welsh Bars, in London	per ton	7	15	0	to	8	0	0	3
Nail Rods	do	8	10	0		9	0	0	2
Hoops	do	9	15	0		10	0	0	
Sheets, single	do	10	10	0		10	15	0	
Staffordshire Bars	do	8	10	0		9	10	0	
Bars, in Wales	do	7	0	0		0	0	0	3
Rails	do	7	0	0		0	0	0	nett
Foundry Pigs, at Glasg, No 1	do	3	3	6		3	9	0	nett
Swedish Bars	do	11	10	0		12	0	0	2½
STEEL:—									
Swedish Keg, hammered	per ton	15	10	0		16	10	0	
Swedish Faggot	do	16	0	0		0	0	0	
COPPER:—									
Sheet and Sheathing, & Bolts	per ton	109	0	0		113	0	0	3
Hammered Bottoms	do	121	0	0		0	0	0	
Flat Bottoms not Hamrd	do	116	0	0		0	0	0	
Cake and Tough Ingot	do	100	0	0		106	0	0	
Best Selected	do	109	0	0		0	0	0	
Fine Foreign	do	109	0	0		113	0	0	
Yel. Metal Sheathing & Rods	per lb	0	0	9		0	0	9½	
LEAD:—									
Pig English	per ton	22	10	0		0	0	0	2½
„ Spanish Sott	do	20	15	0		21	0	0	
Shot, Patent	do	24	5	0		0	0	0	
Sheet	do	22	5	0		22	10	0	
White	do	29	0	0		0	0	0	5
SPELTER:—									
On the Spot	do	22	10	0		23	0	0	net
TIN:—									
English Block	per ton	102	0	0		0	0	0	2½
do Bar	do	103	0	0		0	0	0	
do Refined	do	105	0	0		0	0	0	
Banca	do	97	10	0		0	0	0	nett
Straits	do	96	0	0		96	10	0	nett
ZINC:—									
English Sheet	per ton	28	0	0		0	0	0	2½
Devaux's V. M. Roofing Zinc	do	28	0	0		0	0	0	1*

* And 5 per cent. additional discount if laid upon the new system.

QUICKSILVER	per btl.	8	0	0		0	0	0	3
REGULAS OF ANTIMONY.									
French star	per ton	35	0	0		0	0	0	2

LATEST PRICES OF TIMBER.

TIMBER, duty 1s: per load, drawback 1s:

Teak	load	£11 0	£13 0	
Quebec, red pine		3 5	4 15	
„ yellow pine		2 15	3 15	
St. John N.B. yellow		0 0	0 0	
Quebec oak, white		4 15	5 5	
„ birch		3 10	5 0	
„ elm		3 10	5 0	
Dantzic oak		3 10	6 0	
„ fir		2 10	2 10	
Memel fir		2 0	2 10	
Riga		3 5	3 10	
Swedish		2 5	2 10	
Masts, Quebec red pine		6 10	8 10	
„ yellow pine		5 0	6 0	
Lathwood, Dantzic, fm		5 10	7 10	
St. Petersberg		7 10	5 0	

Deals, per C., 12 ft by 3 by 9 in., duty 2s. per load, drawback 2s.

Quebec, white spruce	13 10	19 0	
St. John, white do	12 10	14 10	
Yellow pine, per reduced C.			
Canada, 1st qual	16 10	19 10	
2nd do	12 0	14 0	
Archangel, yellow	13 0	14 0	
St. Petersburg, yel.	10 0	12 0	
Finland	8 10	10 10	
Memel	10 0	15	
Gothenburg yellow	9 10	11 0	
„ white	8 10	9 0	
Gefle, yellow	10 0	11 10	
Soderhamn	9 10	11 10	
Christiania, per C., 12ft. by 3 by 9 in. yellow	18 0	23 0	
Deck Plank, Dantzic, per 40 ft. 3 in	0 14	1 6	

MISCELLANEOUS.

Oils, &c.

Seal, pale..per ton	50	0	0		Cocoanut, Coch. ton	52	0	0	0
Sperm body	115	0	117	0	Palm, fine	44	10	45	0
Cod	53	0	0	0	Linseed	38	5	0	0
Whale, S. Sea, pale	48	0	53	0	Rapeseed Eng. pale	56	0	57	0
Olive, Gallipoli	56	0	0	0	Cottonseed	36	0	42	10

LONDON COAL EXCHANGE.

	s. d.		s. d.
Hastings Hartley	16 9	Wallsend:—	
Wallsend:—		Caradock	19 6
East Hartlepool	19 6	Hartlepool	19 6
Carway and Duffryn		Tees	19 6
Malting	24 0	Shaw's Hartley	18 6
		North Staffordshire	18 6

Ships at market, 74—sold, 53—unsold, 21. At Sea, 75.

Tenders Sent in for Works.*

Accepted, the erection of a drapery establishment, in Gateshead. Mr. J. E. Watson, architect:—First Contracts.—Kyle (masonry, including old materials), £1,000; Sanderson (carpentry and ironwork), £1,984 10s.; Hastie (slating, including old materials), £173; Glaholm & Sons, (plumbing, including old materials), £353 4s. 9d.; Wilkinson & Co. (plastering), £519 10s.; Firbank & Sons (painting and glazing), £300.

Accepted, enlarging Marlborough-crescent Chapel, Newcastle-on-Tyne. Mr. J. E. Watson, architect:—Kyle (whole of the work), £1,145.

Part of farm buildings at Hendon. Mr. E. Roberts, architect:—Wood, £681 19s. 6d.; Plowman, £650; Donne (accepted), £615.

Villa at Basset, Southampton, Woolcott. Mr. Henry Hall, architect:—Sanders, £2,200; Stevens (accepted), £2,195.

Music-hall, Dover. Mr. Rowland Rees, jun., architect. Quantities supplied:—Simms & Marten, £4,090; McKenzie, £3,917; Stiff & Co., £3,884; Matthews, £3,500.

Sixteen cottages. Mr. F. Chancellor, architect:—Brown (accepted), £2,000.

Alterations and additions to a warehouse, in Silver-street, City. Mr. Herbert Ford, architect:—Sandon & Co., £7,227; Patman & Fotheringham, £7,147; Dove, Bros., £6,975; Browne & Robinson, £6,841; Myers & Son, £6,701; Bradley, £6,657; Brass, £6,647; Hill & Sons, £6,438; Henshaw, £6,070; Rawlins, £5,776.

* Carefully compiled from the trade journals, daily papers, and contributions forwarded to the office.

Warehouse in Bermondsey-street, Bermondsey. Mr. J. Gale, architect. Sewell & Sons, £1,260; King & Son, £1,180; Hill & Son, £1,069; Newman & Mann, £1,025; Wells, £920.

Taking down old buildings and erecting six new houses and stable buildings, in Montpelier-street, Brompton:—Lawrence & Sons, £4,467; Brown, £4,295; Gammon, £4,273; Williams, £4,190; Newman & Mann, £4,105; Stemson, £3,965.

Completing two semi-detached residences, at Forest-hill. Mr. H. F. Hooper, architect;—Evans, £330; Rowles (accepted) £320.

Marine residence, Dover. Mr. Rowland Rees, jun., architect;—McKenzie, £5,530, 10s. 6d.; Sims & Marten, £5 088; Stiff & Co. £4,746; Matthews, £4 500.

Erection of public-house, Mostyn-road, Brixton. Messrs. Hammack & Lambert, architects:—Newman & Mann (accepted), £2,250.

Two warehouses, in Bermondsey-street. Mr. Joseph Gale, architect:—Sewell & Sons, £3,340; King & Sons, £3,192; Newman and Mann, £2,995; Hill & Son, £2,965; Wells, 2,920.

Erection of a new lunatic asylum, Hylton-lane, Bishopwearmouth, Sunderland. Mr John Tillman architect:—For the whole.—Jackson, £3,392; J. & E. Hirst, £2,990; Riddell & Moir, £2,738; Elliott & Harper, £2,731; D. & J, Ranken, £2,695; Marshall, £2,603. Excavation, Drains, Roads, Masonry, Bricklaying, Plastering, &c.—Hodgson, £1,230. Carpenter and Joiners' Work.—Stafford, £924 18s.; Armitage, £800; D. & J. Ranken, £798 10s. Slater's Work.—Preston, £122; Dawber & Son, £106 10s. Plumber's, Gasfitter's, and Ironfounder's Work.—Tomkinson. £313 14s. 7d.; Williams, £303; Whinham, £300 15s. Painter and Glazier's Work.—Bamlett, £82 12s.; Stafford, £82 12s.; Wood, £57 5s.

St. Peter's Schools, West Bromwich. Mr. Smallman Smith, architect. Quantities by Chadwick Bros.:—Hartland, schools, £2,067, boundary wall, £96; Cox, schools, £2,046, boundary wall, £90; Thompson, schools, £1,860, boundary wall, £96; Stonehewer, schools, £1,710, boundary wall, £81; Stockton & Son, schools, £1 676, boundary wall, £82; Nadin & Son, schools, £1,575, boundary wall, £95; Barker, schools, £1,550, boundary wall, £85; Fisher, schools, £1 553, boundary wall, £78; Haffner (accepted), schools £1,385, boundary wall, £78.

Erection of a new warehouse, in Princes-street, West Hartlepool. Mr. J Tilman, architect:—For the Whole.—Hirst & Sons, £1,235; Suggit, £1,177 15s; Johnson, £1,173 11s.; Wright, £1,142; Tuke, £1 090; Marshall, £936 14s. 11d. Joiner's Work.—Stafford £370; Thompson, £340; Tuke, £264 10s. Ironfounder's Work.—Whito, £120. Painter and Glazier's Work.—Windross, £18 10s. Slater's Work.—Salmon, £36. Excavator's, Bricklayer's Plasterer's, and Ironfounder's Work.—Wright, £610.

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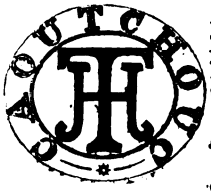

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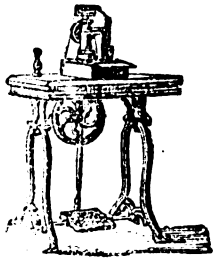

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12 "	16 "
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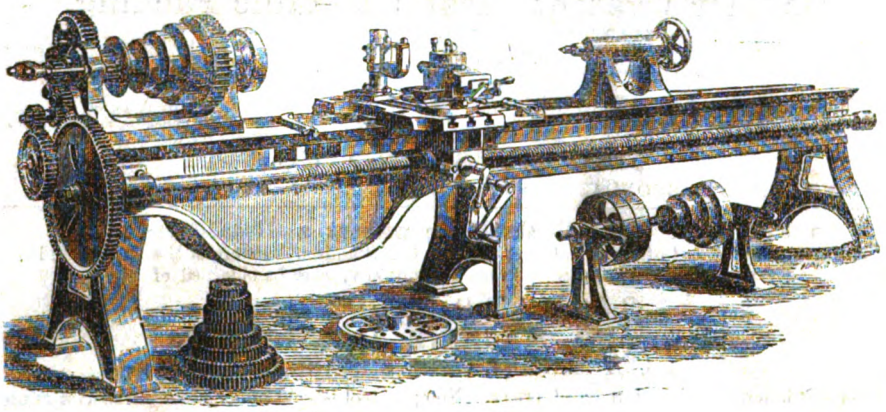
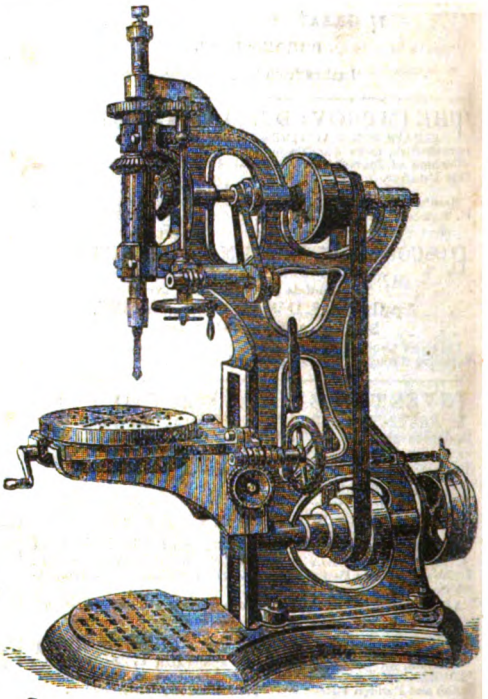
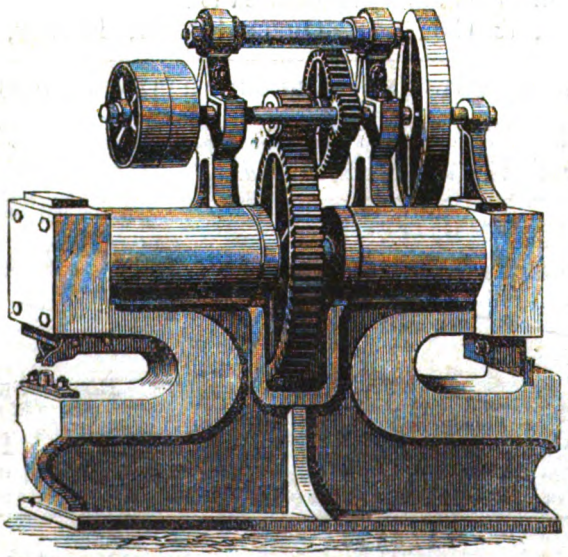
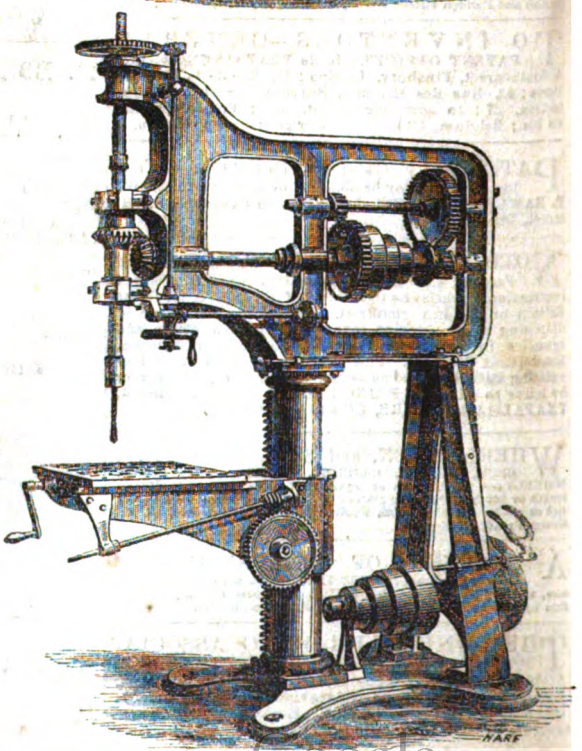
14½ "	20 "
16 "	13 "









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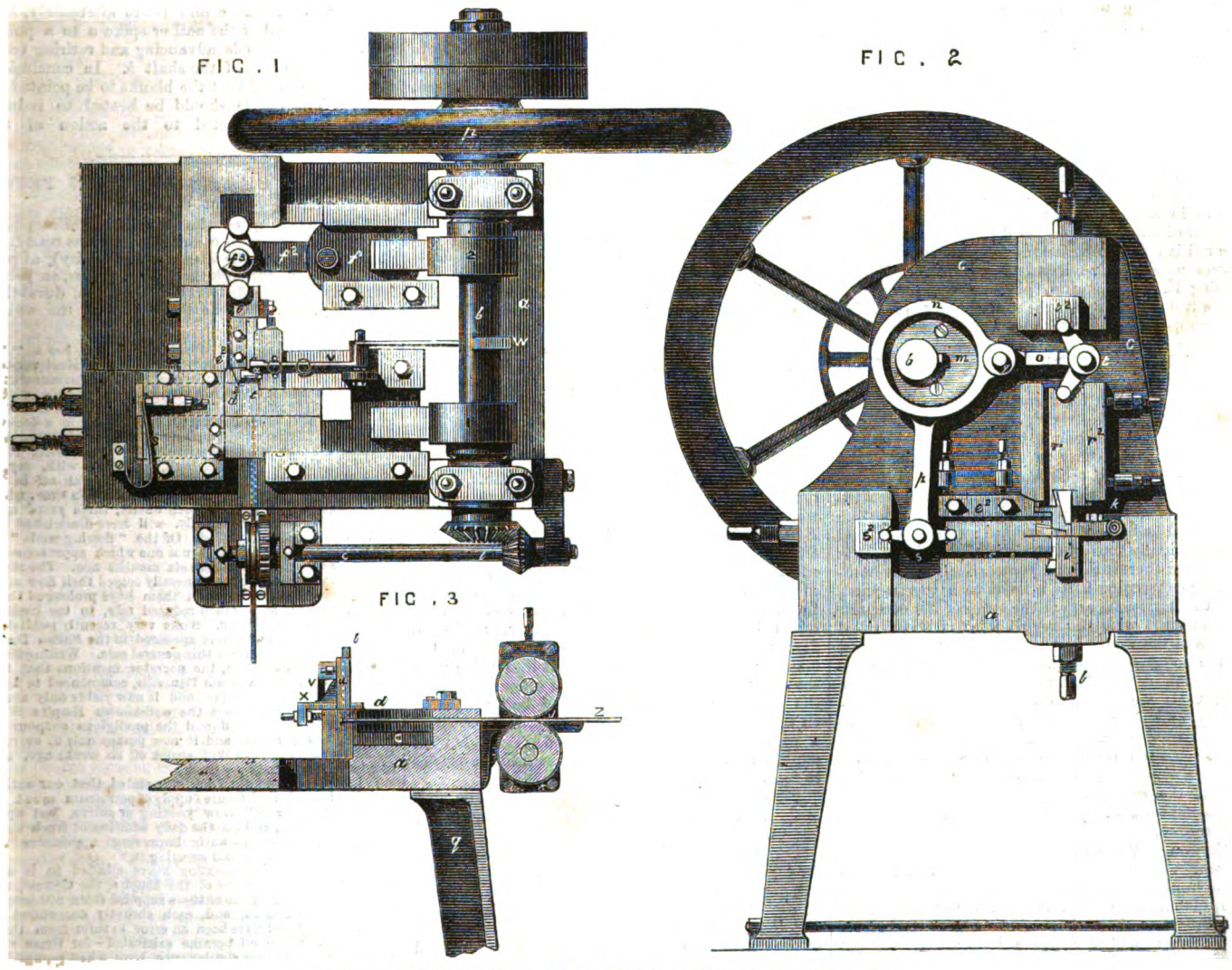
ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

VOL. II.—No. 42.] FRIDAY, JANUARY 12, 1866. [PRICE TWOPENCE.



THE MANUFACTURE OF NAILS, SPIKES, RIVETS, &c.

THE improvements made in machinery for the manufacture of the articles enumerated above are very striking, and those who were early in the field with their appliances for saving labour and keeping up with the times, find that it is impossible for them to accept Earl Russell's advice, and "rest and be thankful:" if they would keep well up in the race they must be ever on the look out for improvements, not only in the matter of quantity but in that of quality also. Among others "entered" in the commercial race is Mr. William Whittle, of Birmingham, who in 1862 obtained a patent for nail-making machinery, which he has recently supplemented by improvements forming the subject of the illustrations and text following.

The improvements effected by Mr. Whittle in the machine by which the nail and other blanks are made, have for their object the effectual removal of the blanks from the machine, and the ready adjustment of the amount of rod fed into the machine. In this machine the cutting off of the rod from which the nail is to be made is effected in the ordinary manner, excepting that the holding dies, by which the rod is held while being headed, are made moveable. The bolting die is made capable of motion, and supported by a strong spring which enables it to yield when the other, or moveable, die advances against it, and causes it to follow the moveable die to a certain distance, when the latter retires. After the rod is cut off it is carried

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by the holding dies in front of the heading die, and headed. The holding dies retire from before the heading die, and when clear of it, open slightly. The rod of which a blank is to be next formed advances and pushes before it the headed blank, which falls from the machine. To secure the complete removal of the blank from the dies, and limit the quantity of rod fed into the machine, a slide is employed, which has a vertical motion. The bottom of this slide is pressed by a spring upon the blank so soon as it has been pushed a short distance from the dies. When, by the advance of the blank, and the pressure of the slide upon it, the said blank falls, the slide descends further, and comes in front of the dies, the advancing rod is fed against the said slide, which then acts as a stop and arrests the motion of the rod when the required length has entered the machine; the said slide works in a bracket, which is capable of being adjusted on the fixed framing of the machine so as to allow a greater or less length of rod to be fed, as may be required. In making blanks which require to be compressed and diminished in diameter under the head, it frequently happens that the slight elongation of the cut off portion consequent upon the compression, and also the pressure of the heading tool, cause a buckling or slight curvature in the blank. It also happens sometimes that the cut off portion of the rod is shaken from its position before it is seized by the holding dies, and a waste blank thereby produced. To obviate these defects Mr. Whittle makes the acting cutter capable of yielding slightly in the direction of the axis of the rod, the yielding portion being supported by a strong spring. There is also employed a holding-down spring, fixed on one of the holding dies, and having a foot-shaped end which works in a recess in the other holding die. The bottom of this end is inclined at the side at which the rod is fed, and as the rod enters the machine it passes under the said end of the spring, slightly raising it. The spring, pressing upon the rod, holds it down firmly on the sliding block, on which it is supported whilst being operated on, and projects the blank from the machine on the opening of the holding dies and the retiring of the sliding block.

In the machine for forming nail points by the action of two tools striking or pressing alternately on the end of the blank, and acting, the one in a vertical and the other in a horizontal plane, the motions of the said tools are effected in the following manner:—On the end of a horizontal shaft is an eccentric, its strap having two arms, the one horizontal and the other vertical; one of the said arms is rigidly fixed to the strap, and the other is connected therewith by a joint. Each of the hammering or pressing tools is fixed to a toggle joint, and the horizontal arm of the strap of the eccentric is connected with the toggle-joint of the vertical tool, and the vertical arm of the strap is connected to the toggle-joint of the horizontal tool. By the revolution of the shaft carrying the cecentric, the said tools are made to advance and retire alternately, and press or hammer the end of the nail to a point, each of the said tools advancing and retiring twice on each revolution of the said shaft. By giving the working tools of the machines for making blanks the required shape, the machines may be employed for making blanks for nails, rivets, spikes, and screws.

Certain of these machines we will now describe in connection with the illustrations. Fig. 1 represents in plan a machine for cutting off and heading the blanks of nails and spikes preparatory to pointing, as well as for making blanks for rivets and screws, and Fig. 2 is a longitudinal vertical section of a portion of the same. The same letters of reference indicate the same parts in both figures.

a is the bed of the machine, upon which the whole of the moving parts are situate; *b* is the main shaft, on which the cams for giving motion to the several moving parts are fixed; *c* is a slide carrying a moveable die, *d*, for holding the rod of metal, *z*, against the fixed die while it is being headed, and also for cutting off the piece of nail-rod before it is headed. The said slide, *c*, is actuated by a cam, 1; *d*2 is the die commonly called the fixed die, corresponding with the moveable die, *d*; *e* is a slide carrying the heading tool, *e*2, which slide and tool receive their motions while heading from the slide *f*, by the intervention of the connecting link, *f*2, and toggle-joint, *f*3. The slide *f* is worked by the cam 2; *j*, *k*, are the feed rolls for carrying the rods into the machine. These rolls receive their motion from the main shaft, *b*, by the bevil toothed wheels, *l*, and counter-shaft, *o*; *p* is the fly-wheel, and *q* is one of the legs or standards of the machine. For the action—

Motion being giving to the main shaft, *b*, a length of rod, *z*, is inserted between the feed rolls *j*, *k*, which rod is carried forward into the machine until its motion is arrested. By the motion of the die *d*, the rod *z* is cut off against the edge *r*, and held between the said die *d* and die *d*2, and carried in front of the heading die *e*2 (fig. 1). By the action of the cam 2, the heading die *e*2 is made to advance and head the blank. Upon the retiring of the heading die *e*2, the die *d* retires, and the two dies *d*, *d*2, separating the headed blank, is removed from the machine. To still further show the improvement of Mr. Whittle, even at the cost of repetition, it may be explained instead of the holding die *d*2 being made fixed, it is made capable of motion, urged forward towards the die *d* by the strong spring *s*, and made to follow the moveable die *d* when the latter retires. The die *d*2 can only follow the die *d* so far as to bring its face up to the edge *r*. The die *d* retiring somewhat further, it is separated from the die *d*2, and the headed blank is free to be pushed out of the dies by the rod of which a blank is next to be formed. In order to completely secure the removal of the headed blank from the dies *d*, *d*2, as well as to limit the quantity of rod fed into the machine, the slide *t* is employed, having vertical motion in the guide *u*. This slide is actuated by the lever *v*, its rising motion effected by the cam *w* on the driving shaft *b*, its descending motion by a coiled spring (not shown). Fig. 2 best shows the action of the slide *t*. By the action of the cam *w* upon the lever *v*, the slide *t*, is kept in the position represented in fig. 2 until the headed blank has been pushed partly from the dies as shown in fig 2. The cam *w* no longer keeping the slide *t* raised, the coiled spring brings down the slide, when it strike the headed blank from the machine as soon as the end of the said blank is pushed out of the dies. The said slide descends below the level of the hole through which the nail rod *z* is fed into the machine, which rod is fed against slide *t*, which acts as a stop when the required length has entered the machine. After the rod has been fed against the slide *t*, the die *d* advances and cuts it off against the edge *r*, and the piece of rod held between the dies *d*, *d*2 is carried to the front of the heading die, and headed in manner already described. The slide *t* is raised by the action of the cam *w*, ready to descend to strike the headed blank out of the machine when it has been brought into a line with the rod *z*. The slide *t* and guide *u* are carried by the bracket *x*, which is capable of being adjusted on the fixed framing of the machine, so as to allow a greater or less length of rod to be fed as required. The heading tool *e*2 has a figure proper to form a head of the required shape.

Fig 3 shows a finished nail or spike of the kind made from blanks headed in the machine (figs 1 and 2).

Fig 4 represents a side elevation of a machine for forming the points of nails and spikes by the action of two tools striking alternately on the end of the blank and acting, the one in a vertical and the other in a horizontal plane. *a* is the bed of the machine, *b* the main shaft, *c* is a standard cast with the bed of the machine, and carrying the parts by which the vertical forging tool *d* is worked, and for carrying the main shaft *b*, *e* is a horizontal slide for carrying the horizontal forging tool *f*. Opposite to the tool *f*, and in the same horizontal plane, is the fixed forging tool *g*, the fixed tool *g* and the horizontal forging tool *f*, both resting on the block or anvil *i*. The stationary tool *g* is adjusted by a draw wedge acted upon by a screw *k*, the anvil *i* is adjusted by the screw and lock nut *l*.

The motions of the forging tools *d* and *f* are effected in the following manner (the mechanical arrangements for giving these motions constituting parts of Mr. Whittle's present invention):—On the end of the driving shaft *b*, an eccentric, *m*, is keyed, the clip or strap *n* working thereon, having two arms *o*, *p*, the one (*o*) being situated horizontally, and the other (*p*) vertically; one of the said arms is fixed rigidly to the clip *n*, and the other is connected thereto by a joint, as before mentioned. In the illustration the arm *o* is connected to the clip *n* by the joint *q*, which joint may be made in the vertical arm *d* instead of in the arm *o* with the same effect. The slides *l* and *r* in which the forging tools *f* and *d* are respectively fixed, work in guides marked *e*2 and *r*2 respectively. The slide *e* is connected to the arm *p* by means of the taggle joint *s*, and the slide *r* is connected to the horizontal arm *o* by means of a taggle joint *t*. The stationary end of the taggle joint *s* works in the bearing *s*2, capable of adjustment by a screw and lock nut, and the stationary end of the taggle joint *t* works in the bearing *t*2, also capable of like adjustment. The moveable ends of the taggle joints *s*, *t*, are connected in the ordinary way to the slides *e* and *r* respectively. By the revolution of the shaft *b* and eccentric *m*, the forgings *f*, *d*, are made to advance and retire alternately, and hammer the end of the nail or spike *u* to a point, each of the said tools advancing and retiring twice on each revolution of the shaft *b*. In conclusion, it should be noted that the blanks to be pointed by the machine (fig 4), should be heated to redness before being subjected to the action of the machine.

DURATION OF THE AMERICAN PETROLEUM WELLS.

At a meeting of the Glasgow Philosophical Society, a lengthened communication was read from Prof. Rogers (of the Glasgow University), at present on a tour through the United States, on petroleum, its nature, distribution in depth, durability of supply, &c. On the latter subject the writer says:—

It is not to be doubted that every oil well has a "life time," or limit to the duration of its productiveness; although in numerous cases the rate of decreasement of yield may not be marked, or even very perceptible, within days, or indeed weeks, though a comparison at intervals of months will almost invariably demonstrate a decided declension. It is almost invariably noticed that the less copious are the most permanent. Furthermore, it is notorious that a "flowing well," starting with, say, a yield of 200 barrels per day, will generally fall off in its product to the extent of 20 barrels in a month's time, while "pumping wells," that in their outset, three years ago, afforded only two barrels daily, will have diminished but little within all that period. Of the "flowing wells" of the whole oil region there is not one which approaches in yield now the product it gave six months ago. The more copious flowing wells have generally ceased their flow after 25 or 30 months; but a few of them have prolonged their supply, though at a much reduced rate, to the limit of three years from starting. Some very recently published interesting statements have appeared in the *Boston Daily Advertiser*, which confirm this general rule. Writing from north west Pennsylvania, the narrator mentions that the Buckeye Well, not far from Titusville, commenced to flow, in 1861, 800 barrels per day, and it now yields only about eight barrels; also, that the well-known Empire Well struck oil in 1861, and flowed the prodigious outpour of 3,000 barrels per day, and it now pumps only 60 barrels. He adds that the Ocean Well struck oil six weeks ago, and is flowing 300 barrels per diem.

It is evident, from the facts here stated, that our anticipations of a sustained future supply of petroleum must be based, not on the wells now yielding or active, but upon new explorations, and on the daily addition of fresh exits for the oil, with constantly improving appliances for economically reaching and securing it.

The suddenness of cessation above alluded to is well illustrated in the history of the Empire, the Coquet, and the Jersey Wells. Each of these supplied from 800 barrels per diem downwards, and each abruptly suspended its flow; but it would have been an error to infer from these ceasings that the oil became exhausted—for these very wells, and many other similar ones, have, when pumped or otherwise assisted, been made to yield a large supply, though never equal to that they gave when they were spontaneously flowing.

A conversation followed the reading of this paper, which turned on the distillation of shale, now so rapidly progressing in this neighbourhood, when it was stated by two of the members that certain sandstones in the vicinity of the city were found to be saturated with petroleum. It was also not considered beyond probability that we might "strike oil" some day in one of the outlying coal districts, which nearly march with the limits of extended municipality.

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The English Mechanic,
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FRIDAY, JANUARY 12TH, 1866.

LONDON, JANUARY 12, 1866.

THOSE who are commonly supposed to have charge of the public morals seize on the end of the year as a fit occasion for bidding their hearers think on what they have well done in the past twelve months, on that which had been better left undone, on fair chances neglected; calling attention also, as the new year surges into view, to what should be taken in hand and what avoided in the twelve months entered on. The same course is often followed by journalists, and, to some extent, we have followed it. There is considerable satisfaction felt by us as we survey our past labours and peruse the commendations showered on us by correspondents. But it should not be forgotten that a great deal of this praise is the meed of the correspondents who from time to time have contributed to the instruction and entertainment of their fellows, and that much of our success is due to the personal recommendations of our readers. For the year now running its course we have taken an important step—as announced in our last number—and, though we have no doubt of the result, still we must in fairness admit that its success depends very much on the readers of the journal. We are but working men ourselves—all connected with THE ENGLISH MECHANIC are working men; and they ask their brother workmen to stand shoulder to shoulder with them in the march forward in 1866. How can this be done? Nothing simpler. The other day a building society with which one of us is connected held its annual meeting. The chairman used our own words about pushing on the society; the question above noted was asked, and the answer given, "If each member will introduce a fresh one, the numbers will be doubled." The advice was taken; some brought two; a large number brought one; and the society now numbers within six of double the number of members it had on its books eight weeks ago! If our old friends and readers, then, will kindly advertise us among their acquaintances, we will accept it as a great favour, and show it in our pages.

One thing we desire attention drawn to is this. Throughout all trades improvements are continually being made in tools, in machinery, and in the method of conducting operations. Whenever practicable, we shall be glad to give publicity to these items, for they are really important nowadays; and the spread of such intelligence is a real boon to hard-working patentees, for to the spread of such intelligence many of them look for their reward. Thousands of working men are designers and patentees. Let them spread abroad the knowledge of the value of this journal, and they will be indirectly but surely benefitting themselves. If they will furnish us with such details of their improvements as they wish published, due publicity will be given to them, illustrated where possible. Anything that is only second-hand will not find room, unless it is really valuable in every day working life.

A look at the pages of THE ENGLISH MECHANIC from its first number to the present time will show the vast space we have devoted to correspondence. This feature will not, now the journal is enlarged, be curtailed, but free scope given to inquirers. The, in very many cases, very valuable answers given to correspondents deserve the widest possible circulation—another reason for the extension of the journal's circulation. In fact, whichever way we choose to put it, the truth is manifest that the more the journal is known and read the greater is the amount of good done. We do not bother the mechanic with a heap of speculative rubbish, and the operative has shown that he is well aware of this. We ask him, then, in all candour and fairness, to give us the benefit of his voice and example among his acquaintances; for that which results in our profit will most assuredly be reflected on him through our pages.

ACCIDENTS IN MINES.

THOSE who are sufficiently interested in this subject to read the annual reports of the Government inspectors in regard to it, must be painfully alive to the fact that the precautions at present observed in mines are quite inadequate to their purpose. The provisions of the various acts of Parliament directed to the prevention of casualties in the prosecution of mining operations, although theoretically excellent, are practically ineffective, and the constant recurrence of fatal accidents in collieries especially, forms the severest commentary upon all past legislation for their obviation. There really is, however, no good reason why the miner should not be enabled to pursue his duties with comparatively much less risk, if not with a far greater degree of personal comfort than he now does. The experience of many years, and the expenditure of many thousands of valuable lives have taught the precise nature of the evils against which he has to contend, and should have taught also the means of guarding him effectually against those evils. It is a reproach to the community, which so largely benefits by the colliers' labours, that it takes, apparently, so little interest in the preservation of the colliers' life. It is true that many ingenious mechanics, and many philanthropic men have from time to time devoted their skill and their money to the noble object of lessening the dangers attendant upon mining, but, alas! hitherto with but small effect. The great task is still unperformed, and every year furnishes accordingly its dread average of victims with unerring certainty. Surely something more should be done to diminish the length of the annual death lists!

We have spoken of past legislative enactments, but it may justly be added that it is incumbent upon Science to be, to a certain extent at least, the guide to Legislation. It is a misfortune that the majority of mine accidents occur out of the sight of any but those immediately connected with mining, and that mining engineering is confined to a very limited class of the mechanical community. Hence the general public, as a rule, regard mining accidents with indifference, and improved machinery and improved appliances for their prevention are seldom heard of. It is very different when accidents occur on our railways, on board our passenger steam boats, or in manufactories. In such cases the results are visible, and it is felt in regard to the sufferers that, although it is "their turn to-day, to-morrow it may be ours also." Selfishness unites itself by a natural process with Compassion; the outcry is great for further precautions; and Science is enlisted on behalf of Humanity. Improvements mechanical, administrative, and executive, follow as a matter of course, and all reasonable, and sometimes some very unreasonable, measures are devised and enforced for the protection of the public.

The poor miner is less fortunately placed; his unobtrusive but invaluable duties are performed beyond and apart from the public track. Those duties are dreary and depressing at the best; but it is sad to think that they are not recognised, and that he who performs them obtains little sympathy and less respect. The exceptional circumstances in which he is placed makes him a totally different kind of being to the generality of his fellow men, and, it must be admitted, makes him also more reckless. The constant presence of danger near him, and the trebly hazardous occupation he consequently follows, tend to imbue him with fatalistic notions, and too often induces an amount of carelessness little short of insanity. It is unfair to condemn him on this account, and to treat him as a social Pariah whose welfare or misery, whose life or death does not signify. Allowances must be made for his eccentricities and his weaknesses; and while attempting to remedy these by educational means, we should employ every available resource—scientific, mechanical, and social—for saving him from their effects. If the miner, from his peculiar pursuits, the force of example, and other incidental causes, becomes, as it were, an isolated individual, having habits and practices unknown to denizens of the upper world, it is the bounden duty of the latter to take all circumstances into account, and to make allowances in accordance with them. Be he what he may, morally, intellectually, and socially, the services of the miner are of infinite value to society, and society owes him in return consideration, and should endeavour, as far as possible, to ensure to him physical safety in the performance of his work.

The foregoing remarks have been partly suggested by the recent terrible explosion of fire-damp in the Gethin coal-pit, and which has destroyed the lives of nearly forty men and boys "at one fell swoop." We do not feel at liberty to comment upon that catastrophe, pending the judicial investigation into the cause of it, but we do say emphatically that in very few of what are known as "firey" mines are the authorities connected with them sufficiently energetic in enforcing the regulations necessary for preventing such disasters. Apathy instead of activity too often prevails among those who are responsible for the lives and limbs of the workers in mines; and familiarity with fatal accidents seems to destroy their energy for inventing or adopting means for obviating them in the future. It is only by bringing the force of popular criticism to bear upon mine owners, mine inspectors, and others concerned, that improvements in mining economy will be evolved, and it is the mission of the press, and particularly the scientific portion of the press, to give a definite form and shape to such criticisms.

It has been computed recently, by a very excellent authority on the subject, that the number of persons connected directly or indirectly with mining, metalliferous and mineral, in Great Britain, is one million. Who shall deny, then, the momentous nature of the interests involved in the question at issue, or attempt to depreciate efforts made for its satisfactory solution? We repeat that it is a moral scandal, in which all share, to find the reports of Government officials repeating year after year the

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"same sad song" of death and mutilation in our coal-pits and mines. Last year the list of casualties of a fatal kind reached the enormous figure of 1,644, and we much doubt if it will not be exceeded in that which is just beginning.

In another paper we shall glance at some of the main causes of the extreme length of these dismal catalogues, and suggest other agencies for shortening them. JOSEPH NEWTON.

BOOKS ON TURNING.*

THE Circle of Mechanical Arts, Thos. Martin, London, 1818. A very good account of the simple lathe, with well-executed drawings and a bar lathe, with screw-cutting apparatus like that of Maudslay. There are, also, one or two boring bits engraved, and the oval chuck is described. This writer, in speaking of Mr. Maudslay, of Westminster-road, Lambeth, says that he "employs the triangular bar lathe for the largest work, the bar drawing out to admit it, and all his lathes are provided with slide-rest and universal chucks, which instrument he first introduced into general practice."

Alexander Tolhausen's specification, No. 392, 1856. An early shape of the Blanchard lathe. The title would lead any one to suppose that the polygonal figures were turned, and not shaped by cutters.

William Heap's specification, No. 809, 1857, employs a screw the whole length of the bed, sunk in a semi-circle hollow in the upper face of front part of bed, against which presses a half-nut from above, resisted by the groove below. This seems to be very faulty, as the friction must be extreme, and the hollow for screw must be an excellent receptacle for chips and rubbish. For stopping or reversing the motion of the screw, he employs a swing frame with cords and pullies in front of the bed.

Stanley Webster's specification, No. 2855, 1857. A method of chucking cog wheels without driving an arbor into them. The chuck has internal teeth to correspond with the one to be turned, the other end is supported by a stud fitting the object and movable head-stock. Another drawing represents a simple plan of turning objects with a face diagonal to the axis-line. A face-plate has a hemispherical boss at the centre, saddled loosely by a plate, to which the object to be turned is chucked. This plate can be adjusted by two screws passing through it and the face-plate, so as to throw its surface "out of the truth" in the fashion of a swash plate.

John Henry Johnson's specification, No. 223, 1859. A lathe with hollow mandril for turning long pieces. Three radial cutters with adjustable mechanism, on a face plate cut up the timber as fast as it is advanced through the mandril by a chain which advances the dogs which grip the spar or other object to be turned. There is a self-acting mechanism for displacing the dogs when they approach the cutters, and the same dogs can be adjusted by a rack and groove, so as to hold the spar or object truly central.

James Greenwood and Jno. Batley's specification, No. 2600, 1859. A novel shape of bed for planing machines and lathe beds. One edge of the V-grove is made vertical, in order to oppose the sideway thrust upon it without imparting a slipping motion with an upward tendency, the fillet is in section like the angle included by the first two strokes of a broad N.

James Eastwood's specification, No. 2684, 1859. An application of the patent mangle-motion to lathes for turning half or more of the circumference of an object, such as the half cylinder surfaces at the angle of cranks.

Josiah Gimson's specification, No. 912, 1863. A mechanism whereby the action of screw cutting in lathes is made continuous, the act of reversing the motion causes a tool to approach on the back side of the screw to be turned.

Samuel B. Ardley, Samuel Beckett and Walton Smith's specification, No. 3254, 1863. A self-centering chuck worked by a rod in a perforated mandril.

Two other patents I have not at hand. The first is Sir W. Fairbairn's lathe with self-acting surfacing motion. A split bush adjustable on the leading screw has a worm on it, which work a set of gear-wheels fastened to the slide rest, and moving the transverse portion at any speed across the surface.

The second by — Everett, Esq., is a very useful back headstock for ornamental turning. The cylinder in which the centre itself is placed, moves in a box which can be elevated between two uprights. With a fly-cutter any object by this movement can be ornamented radially or otherwise on its face, or a circular object can have its edge cut into facets. The second motion is circular and horizontal like that of a spherical rest, by this the sides of pyramids or cones can be ornamented. A third movement is transverse to the bed, and is of use when the eccentric cutter is set in operation. This entire headstock is capable of being shifted to a small cross bed at right angles to the bed, and is supplied with every arrangement needed in eccentric and fancy turning. A detailed description of it with drawings shall, if, agreeable, form the subject of a future communication. In finishing this list I am sorry to say that I have been disappointed in the promise of the German authorities alluded to, and trust that other contributors will add to the meagre number here given. Perhaps some one can describe more accurately the fine lathe exhibited in 1862, by Messrs. Cook, of York, where the vertical face of the bed was planed to receive a saddle enabling the back headstock to pass the saddle and slide rest when convenient.

H. HURST.

* The first portion of this article will be found in Vol. I.

ORE CRUSHERS.

SOME TIME ago we noticed Mr. Bauerman's catalogue of models in the Geological Museum. We this week draw attention to the crushing machinery in use. The crusher breaks down minerals into coarse powder, or into a powder suitable for the smelter. This work is done dry, and a consequent saving effected over the stamping process. The crushers generally employed consist of a pair of cast iron cylinders placed horizontally and nearly in contact, coupled by spurwheels of equal diameter, so that the cylinders have equal velocity imparted to them.

The rollers employed at Tywarnhaile Mines are of unequal lengths, the driver being 24 in. and the follower only 18 in.; both are of 27 in. diameter. They are formed of thick cast iron shells, keyed on to cylindrical bosses, on a pair of plain shafts, which have couplings outside their bearings, connecting them with a pair of lighter shafts, carrying the gearing wheels. The bearings of the shorter roller slide between parallel guides and are kept in position by round bars passing through holes in the frame, which are pressed against by the shorter arm of an unequal armed bent lever, whose longer arm carries a loaded box; the relation of the two arms to each other is as 1 to 9. The object of this arrangement is to save the rollers from fracture in case any unyielding substance should get between them, for when the resistance of any fragment is greater than the horizontal thrust exerted by the loaded arms on the bearings, the shorter roller slides apart from its fellow, and opens a passage for the unbroken substance to pass through. The broken material passes into a drum sieve, 42 in. long and 24 in. in diameter, whose axis is set at an angle of 25° to that of the driving roller, with which it is connected by a pair of level wheels; the smaller wheel on the sieve shaft, having eleven teeth, receives motion from a larger one of 40 teeth. The gauge bar has six apertures to the square inch; the particles passing through are received in a box, closed by a door, through which they are loaded into a truck on the railway below; the coarse fragments are thrown out into the buckets of the raff wheel, or lifting wheel, which resembles a reversed water wheel, being closed on its outer circumference, but provided with a wing of buckets opening inwards; it is 15ft. in diameter, and being coupled to the driving roller makes the same number of revolutions; it discharges its contents on a floor immediately adjacent to the feed hopper, to which they are returned to pass a second time through the rollers. A crusher of this size makes from 30 to 50 revolutions per minute, requiring an effective driving power of from 12 to 20 horses, and will break down a quantity of ores varying from 40 to 60 tons per day, according to the hardness of the associated gauges.

The old pattern Cornish crusher for copper is driven by an overshot water-wheel, with an intermediate train of spur gearing. A crossbar is inserted behind the bearings of the loose roller to receive the pressure of a single balance lever in the centre, instead of using a special weight for each end. The broken stuff is discharged sideways down an inclined shoot into the drum sieve, whose axis is at right angles to that of the rolls, and is driven by a special train of gearing wheels. The coarse fragments are thrown into a rectangular kibble, which moves between wooden guides, and when filled it is lifted by a rope winding on a windlass barrel fixed above the rollers; the shaft of this windlass is slung to the end of a lever, by which it can be lifted out of gear. A coiled spring attached to the plummer block of the loose end keeps it in position when in use. The rollers make four revolutions for each revolution of the water wheels.

Though many apparata have been patented and trials made to secure a share of "mining patronage" they have not succeeded to any considerable extent.

A BOON IN SEWING NEEDLES.

THE place to witness in high perfection the torments of "pulling through" needles on the ordinary handworking system is a girls' charity school room; what some of the young creatures there go through may never be thoroughly known, but it has been appreciated by us on occasional tours among them; and we have often thought that if the plan followed in making some sail needles were adopted in those for ordinary sewing there would be a great deal of labour, patience, and temper saved. We are glad to observe that an easy sewing needle has at last been brought to the attention of the public by the Messrs. Hayes, Crossley, and Bennett, of Worcester (near Redditch). These needles sew much easier than the old ones, and, as a matter of course, the work is better done, and got through more pleasantly. The improvement is this: the needle, while it increases in size from the point to about the middle, tapers from the middle to the eye, yet so as not to weaken its strength or diminish the size of the eye, thus obviating the strain on the fingers in drawing the needle from the work, reducing the necessity for thimble work, and preventing the thread from cutting, owing to the easy passage ensured for it by the improvement in the needle. It is a very small matter, but we are assured that it will prove a real boon to seamstresses.

KIRKALDY'S IRON AND STEEL TESTING WORKS.

(*Continued from page* 177.)

14. The contraction of area at fracture of specimens of steel must be ascertained as well as in those of iron.

15. The breaking strain, *jointly* with the contraction of area, affords the means of comparing the peculiarities in various lots of specimens.

16. Some descriptions of steel are found to be very hard, and, consequently, suitable for some purposes; whilst others are extremely soft, and equally suitable for other uses.

17. The breaking strain and contraction of area of *puddled*-steel plates, as in iron plates, are greater in the direction in which they are rolled; whereas in *cast*-steel they are less.

18. Iron, when fractured suddenly, presents invariably a crystalline appearance; when fractured slowly, its appearance is invariably fibrous.

19. The appearance may be changed from fibrous to crystalline by merely altering the shape of specimen so as to render it more liable to snap.

20. The appearance may be changed by varying

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the treatment so as to render the iron harder and more liable to snap.

21. The appearance may be changed by applying the strain so suddenly as to render the specimen more liable to snap, from having less time to stretch.

22. Iron is less liable to snap the more it is worked and rolled.

23. The "skin" or outer part of the iron is somewhat harder than the inner part, as shown by appearance of fracture in rough and turned bars.

24. The mixed character of the scrap-iron used in large forgings is proved by the singularly varied appearance of the fractures of specimens cut out of crank-shafts.

25. The texture of various kinds of wrought-iron is beautifully developed by immersion in dilute hydrochloric acid, which, acting on the surrounding impurities, exposes the metallic portion alone for examination.

26. In the fibrous fractures the threads are drawn out, and are viewed externally, whilst in the crystalline fractures the threads are snapped across in clusters, and are viewed internally or sectionally. In the latter cases the fracture of the specimen is always at right angles to the length; in the former it is more or less irregular.

27. Steel invariably presents, when fractured slowly, a silky fibrous appearance; when fractured suddenly, the appearance is invariably granulated, in which case also the fracture is always at right angles to the length; when the fracture is fibrous, the angle diverges always more or less from 90°.

28. The granulated appearance presented by steel suddenly fractured is nearly free of lustre, and unlike the brilliant crystalline appearance of iron suddenly fractured; the two combined in the same specimen are shown in iron bolts partly converted into steel.

29. Steel which previously broke with a silky fibrous appearance is changed into granular by being hardened.

30. The little additional time required in testing those specimens whose rate of elongation was noted, had no injurious effect in lessening the amount of breaking strain, as imagined by some.

31. The rate of elongation varies not only extremely in different qualities, but also to a considerable extent in specimens of the same brand.

32. The specimens were generally found to stretch equally throughout their length until close upon rupture, when they more or less suddenly drew out, usually at one part only, sometimes at two, and in a few exceptional cases, at three different places.

33. The ratio of ultimate elongation may be greater in short than in long bars in some descriptions of iron, whilst in others the ratio is not affected by difference in the length.

34. The lateral dimensions of specimens forms an important element in comparing either the rate of, or the ultimate, elongations—a circumstance which has been hitherto overlooked.

35. Steel is reduced in strength by being hardened in water, while the strength is vastly increased by being hardened in oil.

36. The higher steel is heated (without of course running the risk of being burned) the greater is the increase of strength, by being plunged into oil.

37. In a highly converted or hard steel the increase in strength and in hardness is greater than in a less converted or soft steel.

38. Heated steel, by being plunged into oil instead of water, is not only considerably *hardened*, but *toughened* by the treatment.

39. Steel plates hardened in oil and joined together with rivets are fully equal in strength to an unjointed soft plate, or the loss of strength by riveting is more than counterbalanced by the increase in strength by hardening in oil.

40. Steel rivets fully larger in diameter than those used in riveting iron plates of the same thickness being found to be greatly too small for riveting steel plates, the probability is suggested that the proper proportion for iron rivets is not, as generally assumed, a diameter equal to the thickness of the two plates to be joined.

41. The shearing strain of steel rivets is found to be about a fourth less than the tensile strain.

42. Iron bolts, case-hardened, bore a less breaking strain than when wholly iron, owing to the superior tenacity of the small proportion of steel being more than counterbalanced by the greater ductility of the remaining portion of iron.

43. Iron highly heated and suddenly cooled in water is hardened, and the breaking strain, when gradually applied, increased, but at the same time it is rendered more liable to snap.

44. Iron, like steel, is softened, and the breaking strain reduced, by being heated and allowed to cool slowly.

45. Iron subjected to the cold-rolling process has its breaking strain greatly increased by being made extremely hard, and not by being "consolidated" as previously supposed.

46. Specimens cut out of crank-shafts are improved by additional hammering.

47. The galvanising or tinning of iron plates produces no sensible effects on plates of the thickness experimented on. The results, however, may be different should the plates be extremely thin.

48. The breaking strain is materially affected by the shape of the specimen. Thus the amount borne was much less when the diameter was uniform for some inches of the length than when confined to a small portion—a peculiarity unascertained and not even suspected.

49. It is necessary to know correctly the exact conditions under which any tests are made, before we can equitably compare results obtained from different quarters.

50. The startling discrepancy between experiments made at the Royal Arsenal, and by the writer, is due to the difference in the shape of the respective specimens, and not to the difference in the two testing machines.

51. In screwed bolts the breaking strain is found to be greater when old dies are used in their formation than when the dies are new, owing to the iron becoming harder by the greater pressure required in forming the screw thread when the dies are old and blunt, than when new and sharp.

52. The strength of screw-bolts is found to be in proportion to their relative areas, there being only a slight difference in favour of the smaller compared with the larger sizes, instead of the very material difference previously imagined.

53. Screwed bolts are not necessarily injured although strained nearly to their breaking point.

54. A great variation exists in the strength of iron bars which have been cut and welded; whilst some bear almost as much as the uncut bar, the strength of others is reduced fully a third.

55. The welding of steel bars, owing to their being so easily burned by slightly over-heating, is a difficult and uncertain operation.

56. Iron is injured by being brought to a white or welding heat if not at the same time hammered or rolled.

57. The breaking strain is considerably less when the strain is applied suddenly instead of gradually, though some have imagined that the reverse is the case.

58. The contraction of area is also less when the strain is suddenly applied.

59. The breaking strain is reduced when the iron is frozen; with the strain gradually applied the difference between a frozen and unfrozen bolt is lessened, as the iron is warmed by the drawing out of the specimen.

60. The amount of heat developed is considerable when the specimen is suddenly stretched, as shown in the formation of vapour from the melting of the layer of ice on one of the specimens, and also by the surface of others assuming tints of various shades of blue and orange, not only in steel, but also, although in a less marked degree, in iron.

61. The specific gravity is found generally to indicate pretty correctly the quality of specimens.

62. The density of iron is *decreased* by the process of wire-drawing, and by the similar process of cold-rolling, instead of *increased*, as previously imagined.

63. The density in some descriptions of iron is also decreased by additional hot-rolling in the ordinary way; in others the density is very slightly increased.

64. The density of iron is decreased by being drawn out under a tensile strain, instead of increased as believed by some.

65. The most highly converted steel does not, as some may suppose, possess the greater density.

66. In cast-steel the density is much greater than in puddled steel, which is even less than in some of the superior descriptions of wrought-iron.

The following remarks are also worthy of notice:

"The breaking strain per square inch of wrought-iron is generally stated to be about twenty-five tons for bars and twenty tons for plates. This corresponds very nearly with the results of the writer's experiments, of which the following table presents a condensed summary:—

	lbs. highest	lbs. lowest	lbs. mean	tons.
188 bars rolled	68 848,	44,584,	57,555	= 25¾
73 angle iron, &c.	63,715,	37,909,	51,729	= 23½
167 plates, lengthways,.	62,514,	37,474,	50,737 }	= 21¼
160 plates, crossways. ..	60,756,	32,450,	46,171 }	

"Although the *breaking* strain is generally assumed to be about 25 tons for bars and 20 tons for plates, very great difference of opinion exists as to the amount of *working* strain, or the load which can with safety be applied in actual practice. The latter is variously stated at from a third to a tenth. It will be observed that whilst much discussion has arisen as to the amount of working strain, or the ratio the load should bear to that of the breaking strain, the important circumstance of the *quality* of the iron, as influencing the working strain, has been overlooked. The Board of Trade limits the strain to 5 tons, or 11,200 lbs. per square inch.

"It must be abundantly evident, from the facts which have been produced, that the breaking strain, when taken alone, gives a false impression of, instead of indicating, the real quality of the iron, as the experiments which have been instituted reveal the somewhat startling fact, that frequently the inferior kinds of iron actually yield a higher result than the superior. The reason of this difference was shown to be due to the fact, that whilst the one quality retained its original area, only very slightly decreased by the strain, the other was reduced to less than one-half. Now, surely this variation, hitherto unaccountably completely overlooked, is of importance as indicating the relative hardness or softness of the material, and thus, it is submitted, forms an essential element in considering the safe load which can be practically applied in various structures. It must be borne in mind that although the softness of the material has the effect of lessening the amount of the *breaking* strain, it has the very opposite effect as regards the *working* strain. This holds good for two reasons: first, the softer the iron the less liable it is to snap; and second, fine or soft iron, being more uniform in quality, can be more depended upon in practice. Hence the load which this description of iron can suspend with safety may approach much more nearly the limit of its breaking strain than can be attempted with the harder or coarser sorts, where a greater margin must necessarily be left.

"Special attention is now solicited to the practical use that may be made of the new mode of comparison introduced by the writer, viz.: the *breaking strain per square inch of the* fractured *area of the specimen, instead of the breaking strain per square inch* of *the* original *area*."

KING, SMITH, & HOWELL'S (HARTFORD STEEL WORKS, SHEFFIELD) PATENT IMPROVEMENTS IN THE REVERSING AND EXPANSIVE WORKING OF STEAM ENGINES.*

(*Continued fom page* 178.)

By this means can be obtained an unlimited power to move the valves, which is equally effective whether the engine is at work or standing. With the hand wheel out of gear, as shown in the drawing, the engine is supposed to be on a voyage, when, as the valves would require no alteration for some time, *a* and *b* are allowed to run round with the engine, which will possess the advantage of saving

* Communicated by Mr. HENRY J. H. KING, Mechanical Engineer, to the *Practical Mechanic's Journal* for December.

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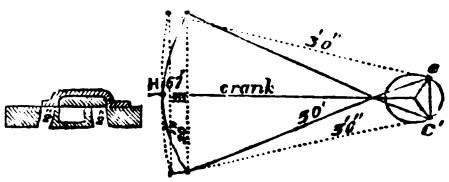
all wear and tear; and if any alteration is wanted in the valves, it is only necessary to push the hand wheel forward and use it as previously described. Having now given a general explanation of the arrangement proposed for working one valve, we proceed to show how a stud pin or single eccentric is qualified to work the valves of a double-cylinder engine, at whatever angle the cranks may be situated apart, and which will be apparent by reference to diagram No. 1; we will suppose the cranks to be at right angles one to the other. The sliding piece, as shown in the diagram, is in a perpendicular position, and the crank of the engine in a horizontal; but after an advance of 90°, the sliding piece will have changed to a horizontal, and a connecting-rod, if now taken off in a perpendicular direction and connected with a rocking shaft, as shown in figs. 6 and 7, will bear the same relationship to the sliding piece as the eccentric rod shown does; that is to say, the sliding piece might now be shifted right across the shaft without practically moving the rocking shaft, so that, if it was communicated to the valve at the other end by a lever, the valve would be in the proper position to work a crank, which might then be at dead centre, and which would be the case with one placed 90° behind *c*. It should here be noticed that care must be taken as to which side the crank shaft the rocking shaft is placed, as this will be determined by the position which the cranks bear one to the other.

Figs. 1, 2, 3, and 4 show different arrangements in which a single eccentric is used as a substitute for a stud pin, and which enables a much neater appearance to be made, as the two pair of wheels are fitted to the interior casting, K, which is bored to fit the end of a crank shaft, and to which it is bolted by means of screws. The part of K on which the eccentric fits is square (in section as shown in fig. 1), and upon which the eccentric, *x*, is fitted, the slot of which is made of sufficient length to allow the centre of the eccentric to pass to the places occupied by the stud pin when in extreme positions. The screw, *s*, is just long enough to fit between the pieces of steel in the end of the slot, and passes through the centre of the wheels, *a* and *b*, similar to that described in fig. 5; but to enable two wheels, *a* and *b*, to turn independently of the hand wheel during a long voyage, two washers, T and U, are provided, fastened respectively to *a* and *b*. T is placed in connection with the hand wheel by means of the clutch, G, and *u* is stopped from turning by throwing into gear the bolt carried by the small bracket, *o*, which falls into the slots shown in fig. 7. It will perhaps at this juncture be advisable to explain what at first sight might appear a little inexplicable; which is, that whatever way the engine runs, the hand wheel must be turned in the same direction to produce the same results upon the shifting of the eccentric.

For instance, suppose the engine is running forward and we wish to reverse, to do which the hand wheel must be turned in the same direction as the engine is running; this will move the eccentric towards the centre until the engine stops, and continuing to turn, the engine will begin to run backwards—but still the hand wheel must be turned in the same direction to put on more steam—which would require a continuance in the same direction of the eccentric that it previously had; this will be explained more readily by supposing the wheels of each pair to be exactly the same size. Then, if the hand wheel, figs. 1, 2, 3, and 4, is turned in the same direction as the engine is running, the nut wheel will make as many less revolutions than the engine by the number of revolutions made by the hand wheel, and we will suppose this moves the eccentric towards the centre of the shaft; but when the engine reverses, the nut wheel will make as many more revolutions than the engine by the number the hand wheel makes; in the one case the screw will run slower than the nut, in the other it will run faster; but as the direction in which the screw is turning is changed with the engine at the same time, the result produced will be exactly the same. An objection to our arrangement might be raised upon the grounds that the rocking shaft would be of considerable length, and that the valve worked by it would have an incorrect motion imparted to it, in two ways: 1st, that the valve would open behind time, and, also, that the distance travelled by it would not be equal to that on the opposite side. The first of these objections can be compensated for by making the angle of the eccentric rods a little more, or less, as the case might be, than that at which the cranks are set, and the second by making the lever in connection with the valve a little longer than that which is in connection with the motion. In estimating the advantages possessed by a motion of this description beyond that of the link motion, let us take an example, such as is commonly used upon marine engines, and calculate the effect produced upon the lead in the valves up to the point where the steam would be cut off at one-quarter stroke; and the importance of this investigation will appear apparent, when it is remembered that up to this point the link can alone be relied upon as a variable expansive gear, when the gridiron valve is used as a variable expansive valve of this kind, when the lap in the main valve is equal to the width of the port will not cut of later than one-quarter stroke.

We take an example in which the proportion of the valve is the same as diagram 1, but which is worked by the link motion, diagram 2, the length



of the link from centre to centre being equal to 2 feet, and the length of the eccentric rods equals 3 feet, to total travel of the valve being 8 inches. The crank is at dead centre, and the eccentrics, *c* and *i*, are in the proper position for working the engine either backwards or forwards, and while in this position the link ought to be shifted from one side to the other without moving the valve; we will suppose that the rods are uncrossed in the first instance, as shown by the dotted lines, then the proper curve for the link would be that shown by the dotted centre, and by calculating the versed sine of this arc, we find it must equal ·867 of an inch; but if we now suppose the rods to be crossed, as shown in the diagram by the strong lines, we find that the circumstances become much altered, and the curve of the link would require to be a great deal larger, and we find when in this position the versed sine of the arc would require to be 3·331 inches, and as the rods will be crossed when the crank is at one dead centre, and uncrossed at the other, while in both positions the valve ought to have no movement at all. When the link is

Fig. 5.

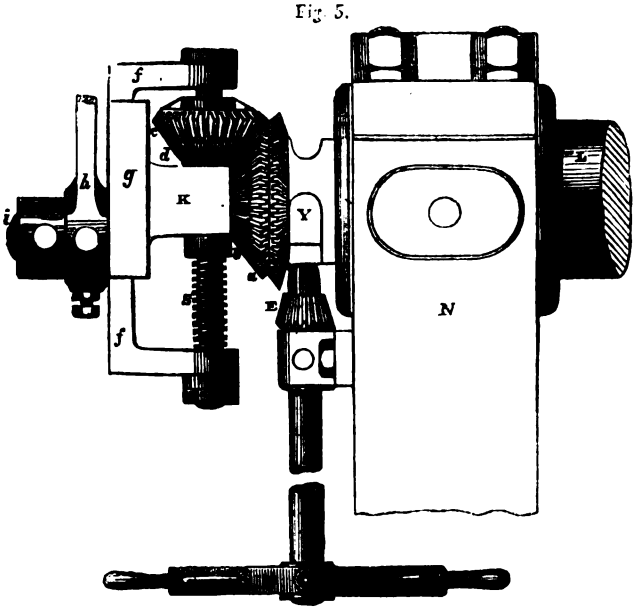
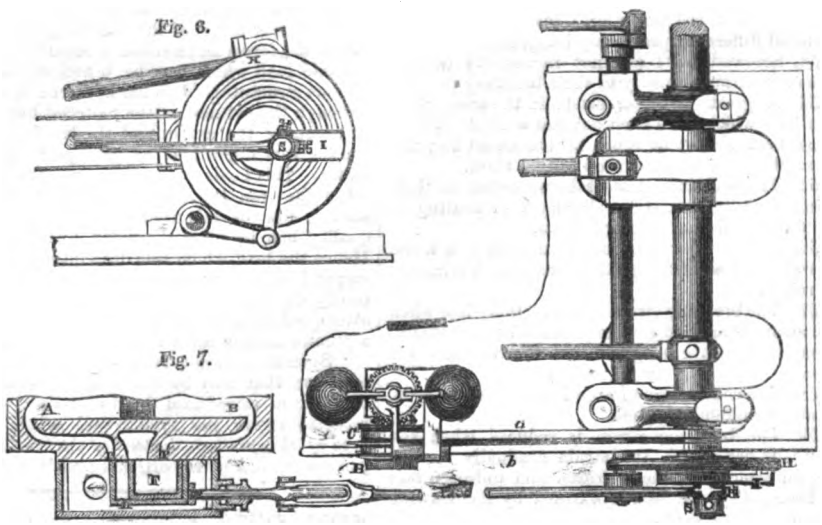


Fig. 6.

Fig. 7.



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shifted from one extreme to the other, an inequality will be introduced which will be best contended against by making the curve of the link a mean between the two, which would make the

$$\text{versed sine} = \frac{\cdot 869 + 3\cdot 331}{2} = 2\cdot 099 \text{ inches. If}$$

this is adopted, and the rods are crossed, as shown by the strong lines, when the eccentrics point away from the link, an advance of lead would be given to the valve as it approached mid gear, which would amount at that point to 1·232 inches, or nearly 1¼ inches, and the same result would be produced upon the other centre; while, if on the other hand, the rods are uncrossed when the eccentric points away from the link, the valve would cover the port by 1·232 inches, which would have to be uncovered before any steam could be admitted to the cylinder; this would of course be worse than opening the port too soon, which will show the importance of crossing the rods in the proper direction, but, in either case, the inequality produced by short rods would be so great as to militate very strongly against the use of the link.

(To be continued.)

REVIEWS.

Constitutionalism of the Future; or, Parliament the Mirror of the Nation. By JAMES LORIMER, Regius Professor of Public Law in the University of Edinburgh. Edinburgh: Adam and Charles Black.

The name and repute of the author will secure for his work, at the present time, a large number of readers: we doubt if it will number its admirers by its sale. We have perused it with pleasure, and find that the just principles of political economy may be therefore acquired in an easy and interesting manner. Mr. Lorimer is of opinion that during the last decade or so, "the average national mind has become deeper, more thoughtful, more consistent; and has thus been unconsciously preparing itself for the reception of the science of politics which its own advancement foreshadowed." There are more than the Professor who think in this wise, and have done so for at least ten years; the cotton famine showed it; and people generally wait to see what the new Government intend to do in the matter of extending the franchise. There is no doubt, we think, and so does the Professor, that it is in spite of the anomalies of our Constitution, and not in consequence of them, that we have prospered—in simple truth, we Britishers have a habit of making circumstances, and not they us. We are glad the Professor sees that his countrymen have been hard at work, doing so well for the last half century and more. Approaching the Professor's own opinion on representation, we find him stating that "our representative system must accept and conform itself to the arrangements of Providence, or, in other words, to the facts of nature as exhibited in society." (!) "Human inequality is a fact of nature which society exhibits; therefore our representative system must accept and conform itself to the fact of human inequality as socially exhibited." That is to say, he repudiates the doctrine of equality, and the consequent claim for the extension of equal power—for universal suffrage "is the grace of all temperate liberty, and the parent of tyranny and licence." As a remedy for the evils and defects pointed out in the book, Mr. Lorimer suggests a system which, like every other broached, will find supporters. He will give a vote to all men not *dis*qualified, and enable them to increase their power of representation, as they display merits of various kinds. Thus:—"An ordinary rough, who had no other qualification except that he was a British subject, labouring under no *dis*qualification, would have *one* vote. If he has attained the age of 51, and could read and write, he would have *five* votes. If he got so far as to pass the middle-class examination, and to pay income tax on £200 a year, he would have *nine* votes. The graduate of a university, 41 years of age, who had £500 a year, and was a member of the bar, would have—as a citizen, 1; age and experience, 2; property, 3; education, 4; and profession, 4=14 votes. And the maximum attainable would be—citizenship, 1; age, 3; ex-M.P., 3; £10,000 a year, 10; university degree, 4; and profession, 4=25 votes." Beyond all this there is some very excellent reading matter on "parties," and the tone of the volume is sound; but we are certain his system of marks, or "fancy franchises," will not find much favour with our readers. That there will have to be some "fancy" work introduced into the scheme which will best "go down" we feel assured, but it will not be that indicated by Mr. Lorimer.

BRITISH GOLD.

By ROBERT HUNT, F.R.S.*

The discovery of gold in Great Britain has, from the earliest recorded time, been a question of much interest. There is every reason for believing that before the Roman invasion this precious metal was known to the inhabitants, and prized by them. Julius Cæsar was induced to the invasion of these islands from the report of the immense mineral treasure possessed by the people; and Tacitus, in his "Life of Agricola," distinctly tells us, "in Britain are gold and silver and other metals." The early discovery of gold, even by ignorant men, is easily explained. It would be found in the beds of streams, left dry in summer, and the density and colour of the stone would very naturally attract attention. The metallic nature of the discovery would be readily detected by men who had already made themselves familiar with tin; and it is well to remember that all evidence is in favour of the belief that tin from these islands formed an important element in the commerce of the eastern world as early as the days of Solomon.

Samuel Rush Meyrick infers, from the "Triad" which celebrates Caswallan, Manawydan, and Llew-Llawgyfes as three chieftains distinguished by the possession of golden cars, that the mines of North Wales were worked by the Cymri at a very early period.

Cimboline, Prince of the Trinobantes, is known to have coined money of gold, and the probability is that this was obtained in these islands. The cross of Cong, the torcs, and various gold ornaments which have been found in Ireland, and which are preserved in Dublin and elsewhere, are remarkable examples of a tolerably advanced state of manufacture amongst, in other respects, a very unsettled people, and they prove the existence of gold amongst them in considerable quantities. It is thought by those who have examined the subject with care, that the gold was all found on the slopes of the Croghankinsella mountain, and in those streams which have made the county of Wicklow famous. That the Romans discovered gold in England and Wales is certain. We have the statement of Tacitus already quoted, and we have the evidence of the remains of Roman mines, which were worked for gold, in several parts of the country, the most remarkable being the gold mine—Ogofau or Gogofau—near Pumpsant, in Carmarthenshire. Here, situated on the left bank of the Cothy, and forming part of the grounds of Dolau-Cothy, are the curious remains of mining, which have been well described by Mr. W. W. Smyth. For some distance the quartz lode has been "worked open to day," and galleries and levels have been driven 170 feet through the slate. In evidence of the auriferous character of this working, are the facts that the officers of the Geological Survey discovered gold in one of the quartz lodes at Dolau Cothy, and that a metallurgical workshop was found; and amongst other curious remains a gold necklace, which is now in the possession of Mrs. Johnes, the wife of the gentleman to whom this property belongs. Other instances might be cited, if it were necessary, in proof of the former existence of gold in tolerably large quantities in many parts of these islands.

The streams which were washed in ancient times were, without doubt, exhausted of their treasures by the eager searchers, and hence the reason why we find traditions of the existence of gold clinging to spots where no gold can now be found. We have witnessed, within our own time, the exhaustion of many an auriferous district in California and in Australia, and without doubt the same process went forward in this country as has been for some years active in those distant lands. Even now the "tin streams" of Cornwall are not entirely exhausted of their gold. From the earliest period the "streamer" has carried his "quill," in which he deposits the little spangles of gold which from time to time present themselves to his discriminating eye. These quills of gold, when filled, are sold at the nearest town. Occasionally little nuggets have been found. In the Scorrier Collection of Minerals are two as big as small beans; and examples are to be found in other private collections, in Cornwall, in the British Museum, and in the Museum of Practical Geology, in London.

There has been a constantly prevailing idea that gold mines were to be discovered in this country, and we find our monarchs, with much avarice, claiming, under the term of "Mines Royal," the right to all the precious metals which might at any time be discovered. Sir John Pettus, who was especially the agent of Prince Rupert, thus defines a "Mine Royal":—

"When the ore does not yield so much gold and silver as will exceed the cost of refining and the loss of the baser metal, it is called a *poor mine*. But when the ore yields gold or silver to an amount which will exceed the charge of refining and the loss of the baser ore, it is called a rich ore, or a *Mine Royal, and is appertaining to the King by his prerogative.*"

A few further notes on gold seeking in the British Isles will not prove uninteresting. In 1526 James V. of Scotland granted to certain Germans the right of working, under conditions favourable to the Crownoroyalties, the gold and silver mines of that country for forty-three years. Elizabeth had previously made similar grants to Houghsetter, Thurland, and Schutz. In neither case, however, do we learn of any gold mines having been discovered. In one part of Devonshire those miners gave the names of "Gold Street" and "Gold Field" to spots where lead and silver, but no gold, are still found; and it is probable that they worked over the valleys near North Molton, in which the Britannia and Poltimore mines are situated. A few years since these mines gave rise to poetic prospectuses speaking of "Pactolean streams flowing through the lovely valleys of Devonshire," and holding out the hope of "a realization of the fable of Colchis and the Golden Fleece." In 1593 James VI. of Scotland granted "Crawford and Glengomar to Thomas Foulis, goldsmith, of Edinburgh, for twenty-one years, in consideration of the great sums due to him by his Majesty and his dearest spouse." This grant had especial reference to the reported discovery of gold in the Lead Hills district of Lanarkshire, and it was hoped would pay off the debt, £14,594, due to the Edinburgh goldsmith. We learn, however, incidentally from another authority that "the King expended £3,000 on Crawford Moor and obtained not quite three ounces of gold." Pennant, however, says, on what appears to be very questionable authority, "in the reigns of James IV. and V. of Scotland was procured in the Lead Hills from gold washed from the mountains, especially in the reign of the latter, not less than the value of £300,000 sterling." We are also told that a piece of gold weighing thirty ounces was then discovered. Sir Bevis Bulmer and five other gentlemen were empowered to work all the supposed auriferous districts of Scotland, and also the silver mine of Hilderstone, near Linlithgow, which was discovered in 1607. In 1616 Atkinson, a gold refiner, obtained a grant from the Privy Council, which was confirmed by James, "to search for gold on Crawford Moor, paying the king one-tenth." The inducements which were, from time to time, held out to capitalists to embark in the great gold adventure of the Lead Hills, clearly prove the unprofitable nature of the search for gold. The most amusing—as showing how skilfully the King and Atkinson ministered to human weakness—was an order of council instructing Atkinson "to move twenty-four gentlemen of England, of sufficient

* Extracted from the *Quarterly Journal of Science* for October. Churchill and Sons.

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land, to disburse £300 each," . . . . for which they were to be created for ever "*Knights of the Golden Mines.*" Again and again the cry of gold has been raised, and the result has ever been the same—renewal of a large expenditure of money, the finding of but little gold.

After the Lead Hills the most notable example of gold seeking has been in Ireland. In 1795 gold was picked up in the valley on the flanks of Croghankinsella, and tolerably active workings were carried on by the Crown, under the direction of the Commissioners, Messrs, King, Weaver, and Middleton, until the Rebellion of 1798. The Crown during this period raised 944 ounces of gold, of the value of £3,675. It was stated recently at a meeting of the Geological Society of Dublin, that a family named Byrne, who were farmers at Croghankinsella, found in the upper part of one of the rivers a mass of metal, about a pound and a half in weight, which they supposed to be copper. It remained many years in their possession, and was used by them as a weight. They disposed of it at length to a travelling tinker, who carried it to Dublin, and sold it for a large price to a jeweller in Capel-street. This, or some such circumstance, led the Government to organize the commission for thoroughly examining the valleys of Wicklow. Dr. Houghton, at the meeting already referred to, said, "the subject was a most interesting one, and the Society was the proper place for the discussion of it. The first point that occurred to him was the extraordinary manner in which the gold occurred in the localities referred to. The large 'model,' which had just been inspected by those present, represented a very celebrated Wicklow nugget, which some people said had been presented to George IV., but which others said that that monarch took the liberty of stealing out of this country. . . . . The peculiarity of it was that the gold appeared to consist of masses conglomerated or lumped together." This "model" represented the largest well authenticated nugget of rolled gold ever found in Europe, and which weighed twenty-two ounces.

Excellent descriptions of the Wicklow auriferious district will be found in a memoir by Mr. W. W. Smyth, which embraces also a careful examination of the mines of lead and pyrites.

(*To be continued.*)

ON PURE WATER.*

By EDWIN LANKESTER, M.D., F.R.S.

Pure water is as necessary for health as good food or fresh air. Yet it is probably more neglected or less understood in modern times than either. I say modern times, because there is reason to believe that amongst the nations of antiquity, the Romans, at least, took more pains to obtain pure water than we do. It may be that our habit of taking water with something to flavour it, in the form of tea, coffee, sugar, salt, alcohol, or other agent, has rendered us less alive to the necessity of pure water than were people who had less means of indulging a taste for flavours than we have. Whether this be the case or not, terrible have been the inflictions on society from the neglect of a supply of pure water.

One example by way of introduction. In the year 1854 the cholera ravaged the metropolis. Up to August 31st of that year not more than twenty cases had occurred in the parish of St. James, Westminster. On that night upwards of 100 cases of cholera occurred in the neighbourhood of Broad-street, Golden-square, and more than half died. The next day the disease increased, and for four days it went on. Never was such mourning and desolation known in London since the days of the great plague. Upwards of 600 persons were killed in those five days. What could be the cause of this terrible outbreak? At first all was confusion. In the midst of the plague the late Dr. Snow accused the pump in Broad-street. It was shut up and the plague ceased. After this event the vestry appointed a committee to investigate the subject. On that committee were Dr. Snow, Dr. King, Mr. Marshall, the Rev. Mr. Whitehead, myself and others. We investigated the whole attack from house to house. At last the fact became only too evident that wherever the water had been drunk from the pump in Broad-street between the 31st of August and the 4th September there cholera had been the result. The pump was afterwards examined, and it was found that the well communicated with a cesspool in an adjoining house. No evidence can be more convincing than that brought forward by this committee, that the impure water of this pump was the active cause of the outbreak of cholera. I bring forward this case now as it may be a timely warning, and also as an illustration of the importance of securing, at least for drinking purposes, pure water.

As an organic being, man requires water for the performance of the functions of his life. Water is necessary to the existence of the universal world. Rocks and the inorganic substances of the earth assume their forms in obedience to the influence of water. The great physical features of the earth's surface have been determined by the action of water. As it assumes the solid, liquid, and gaseous forms under the influence of heat, it is one of the great agents of change upon the surface of the earth. Plants and animals may be regarded as organised water. There is no life upon the globe without water. Many of the lower forms of animal and vegetable life consist mainly of water. A jelly fish, weighing many pounds, was found to contain only a few grains of other constituents. All organic matters when dead lose a great portion of their weight when exposed to heat, on account of the evaporation of the water which they contain.

The life of plants and animals is maintained by the chemical changes which go on in their tissues by the agency of the organic elements, carbon, hydrogen, oxygen, and nitrogen. But these elements are not conveyed into the plant or animal in their pure form. The plant takes them up in the form of carbonic acid and ammonia. Neither are these compounds taken up in their pure form. They are conveyed into the tissues of plants by the agency of water. Each drop of rain, as it descends for the nourishment of the vegetable kingdom, contains its quota of carbonic acid and ammonia, and it is the water which is absorbed, and which carries into the system of the plant these compounds. Not only are the organic elements thus carried, but the mineral constituents of plants, the salts of lime, soda, and potash, are thus conveyed. Arrest the supply of water and all nourishment ceases.

The same is the case with animals. Not only is water necessary for the constitution of their bodies, but all the substances which maintain animal heat, and which nourish the animal tissues, are dissolved and carried into the body by the aid of water. Nay, even when these substances are oxidised and changed, and are no longer fitted for the purposes of life, they are carried off from the system by the aid of water.

Man is no exception to this law. His body is composed mainly of water. The constituents of a man's body, weighing 150 pounds, might be easily divided into five parts, each of which could be placed in an ordinary-sized pail, holding 32 pints. All the solid constituents of a man's body would go into one pail, whilst the other four would contain the water. In more accurate figures, the solid constituents of a man's body, weighing 154 pounds, would be 43 pounds of solid and gaseous matter, and 111 pounds of water.

Neither the water nor the other constituents of a man's body are permanently retained. Life does not so much consist in the chemical changes which our daily food is undergoing as in the destruction of the tissues which are formed out of the food. Blood, muscle, and nerve formed from the food of yesterday become the source of active life to-morrow. That which to-day is available flesh is to-morrow rejected from the system. The water of the tissues is removed at the rate of from 80 to 100 ounces a day. Of this 50 ounces pass off by the kidneys, 30 by the lungs, and 14 by the skin. Of course season affects these quantities, and the larger the person and the greater the drinker, the more water is got rid of.

Not only is water necessary to the sustaining of the human body, but all other constituents are taken into the body by its agency. All our food naturally contains water. Here is the result of analysis of various articles of food. One hundred pounds contain the following quantities of water:—

Potatoes	75	lbs.
Cabbage	92	"
Flour	14	"
Rice	13	"
Bread	44	"
Milk	86	"
Beef	50	"
Mutton	44	"
Fish	78	"
Eggs	80	"
Cheese	40	"

From this list it will seem that all our ordinary food contains water. But this is not enough to carry the various substances we use as food into the system. The sugar, the starch, the oil, the fibrin, and albumen must all be dissolved and carried into the system by the aid of water. Hence we partake of beverages. We drink tea, coffee, chocolate, beer, soup, and other fluid foods. In all these cases we are merely flavouring the water which it is necessary for us to take in order to enable the stomach to dissolve and take up the more solid forms of our food,

The quantity of water contained in the meat, bread, and vegetables of which man indirectly partakes in his food is about one-fourth of the quantity of water he requires for daily consumption. The only food which is ever substantially supplied to him, and this only in his infancy, which requires no addition of water, is milk. Potatoes contain nearly as much water as milk, and those who live entirely on potatoes require but little water. A curious proof of this was observed during the potato famine in Ireland. It was observed as a remarkable fact that in their great poverty the people of Ireland were consuming larger quantities of tea, coffee, and sugar, which might be regarded as luxuries. The increase, however, of these luxuries depended on the fact that whilst the starving people of Irrland were fed with rice, flour, and other dry food, as substitutes for the potato, they were obliged to have recourse to water for drink. As in the case of all other civilized people, they preferred their water flavoured, and partook of tea and coffee sweetened with sugar.

Water, then, being essential to the life of man, let us inquire into its natural sources and fitness for the *dietetical* uses of man. Water exists naturally upon the surface of the earth, in its interior, and in the atmosphere. The heat of the sun daily carries enormous quantities of water into the atmosphere, from whence it is precipitated upon the earth in the form of snow and rain. This percolates into the earth from whence it comes again in the form of springs, and may be reached by digging wells. Much of this water finds its way into rivers with the rain from the surface, and these empty themselves into the ocean. As the water in its course from the atmosphere to the sea dissolves all soluble matters it meets with in the earth, and these are not evaporated again, sea water is a strong solution of various salts. The principal of these is chloride of sodium. The following analysis of sea water from the German Ocean gives the other constituents:—

Solids in 100 parts of water	3·15
Chloride of sodium in 100 parts of solids	77·78
Chloride of magnesium " "	8·12
Chloride of potassium " "	0·97
Chloride of calcium " "	1·38
Bromide of magnesium " "	0·47
Sulphate of lime " "	3·49
Sulphate of magnesia " "	6·79
Carbonate of lime " "	0·56
Silicate of soda " "	0·25
	100·00

The sea also contains oxygen and carbonic acid gas. Sometimes the water which passes into the earth comes up highly charged with mineral constituents. When such waters cannot be ordinarily drunk, and are supposed to be medicinal in their action, they are called *mineral* waters.

(*To be continued.*)

* From the *Popular Science Review*.—Robert Hardwicke, Piccadilly.

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THE ELECTRIC RAY OF THE ENGLISH CHANNEL AND OTHER ELECTRIC FISH.

In a paper communicated recently to the French Academy of Sciences, by Mr. Charles Robin, occur the following statements regarding certain electric fish:—

"The varieties of these fish are but few in number; the *raya*, ray, or skate, the *gymnotus electricus*, or electric eel, and the *silurus electricus*. The *raya* belongs to the skate family, hence they are sometimes termed electric skates, while fishermen call them tremblers, or magic fish. This fish has a smooth, flat body and short tail, resembling somewhat an almost circular disk. There are several kinds to be found on the coasts of Provence, and the channel between France and England. If a ray be taken up in the hand a strong shock will at once be felt, so violent as to benumb and even paralyze the entire arm during several minutes. The sensation may be compared to that experienced from a violent blow on the elbow. The force of the shock is estimated as equal to that of a pile of 100 to 150 pairs charged with salt water. The discharges succeed each other with very great rapidity, as many as fifty discharges having been counted in one minute. A shock can be given to twenty persons simultaneously, if they stand touching each other in a circle, with the two persons at each end touching, the one the back and the other the belly of the ray. It has been discovered that the back of the fish emits positive and the belly negative electricity. After a fisherman has emptied the contents of his net into his boat, if he pours a large quantity of salt water upon the fish, should there be an electric ray among them, he is at once apprised of the fact by a shock in the hand he uses to pour out the water.

"Plutarch mentions this peculiarity as having been known to the ancients. The discharge from the ray emits sparks similar to those of an electric machine, produces magnetization and chemical decomposition, and gives marked signs of heat when passed through a thermo-electric pair.

"The electric organs are of three kinds, viz.:—

"First, In the lower half of the body and at each side of the head there are several hundred small tubes (Hunter counted as many as 1,182) or membraneous, vertical prisms close together, like honey-combs, and subdivided by horizontal partitions into little cells filled with mucus.

"Second, In the hinder part of the brain there is a lobe known as the electric lobe. Every time that this lobe is touched strong discharges are produced, even if the organ be separated from the brain and spinal marrow. All action upon the body of the ray, determining the discharge, is transmitted by the nerves from the irritated spot to the electric lobe of the brain.

"Third, Three very large branches of the fourth pair of nerves start from the above lode and communicate with the electric batteries. If these nerves be cut or tied all electric phenomena ceases; but in order to completely prevent any discharge they must all be tied or cut, for if they are only cut or tied on one side of the body the discharge will continue on the other side.

"The *gymnotus* is similar to an eel in appearance, and is commonly known by the name of 'electric eel.' These eels average about seven feet in length, and their skin is covered with a glue-like substance. They abound in the rivers and lakes in certain parts of South America. Their electric power is so great as to knock down men and even horses. Whenever a fisherman chances to catch a *gymnotus* and a young crocodile in the same net, when it is hauled in the latter reptile is generally found dead or paralyzed, while the electric eel shows no mark—the crocodile having been electrified before it could reach the fish.

"In certain sections of South America when it is necessary to enter a pond or stream of electric eels, wild horses are driven into the water infested by these formidable fish. Humboldt describes the method pursued. As soon as the eels hear the unusual noise caused by the plunging of the horses they rise to the surface and attack the animals with their powerful electric batteries. The natives surround the pond or occupy the branches of trees overhanging the water, armed with harpoons and long reeds, and by their wild cries and reeds prevent the horses from landing. After a desperate combat, in which many horses are often killed and others paralysed by the repeated and terrific shocks of electricity, the *gymnoti* being weakened by fatigue and loss of galvanic power, seek to escape in order to rest themselves and recuperate their electric strength, when the horses remaining drive them to the shore, where they are easily captured by the harpoons attached to ropes.

"Professor Faraday has described the characteristics of the electric discharge from these fish. By the aid of two metal plates joined to the extremities of the galvanometer and applied to various points on the body of a *gymnotus* he succeeded in determining the direction of the discharge. He discovered that the anterior portion of the eel always formed the positive pole, and the posterior portion the negative pole, so that the direction of the current in the galvanometer was from the head to the tail. By causing the discharge of the *gymnotus* to pass over a wire arranged in a spiral, in the interior of which several needles were placed, he succeeded in magnetizing these needles in the required direction, by the direction of the discharge from the head to the tail of the fish. The same philosopher obtained chemical decomposition by the employment of iodide of potassium, and produced the electric spark by introducing into the circuit an electro-magnetic spiral, having a cylinder of soft iron in its interior.

"The electric apparatus of the *gymnotus* extends over the entire length of the back and tail, and consists of four longitudinal fasciæ, composed of a large number of membraneous laminæ, nearly horizontal, parallel, and very close together, and united by an infinite number of scales placed vertically and crosswise. The little prismatic, transverse cells formed by the junction of these laminæ are filled with a gelatinous substance. The whole apparatus is supplied with very large nerves emanating from the spinal nerves."

ON THE SUBLIMED OLIGIST OF VESUVIUS, AND ITS ARTIFICIAL PRODUCTION.*

BY DR. T. L. PHIPSON, F.C.S. &c.

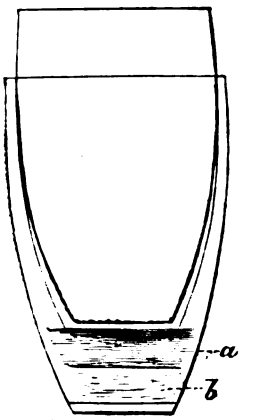
Among the volatilised or sublimed mineral productions of Vesuvius, oxide of iron has been frequently remarked. It was very scarce in the eruption of 1850, but exceedingly abundant after that of 1855, and was plentifully deposited on the scoriæ of the little cones. Professor Sacchi also observed it on the torrent of incandescent lava in the Atrio del Cavallo. No less than five distinct kinds of sublimed oxide of iron have been recognised at Vesuvius. The first, crystalised in small laminæ of a red colour not unlike that of protoxide of copper, generally forms a crust from one to two millimetres thick. The second variety forms small stalactites of a brownish red colour, generally mixed with 40 to 50 per cent of other substances. The third variety, which is the commonest of all, consists of bright metallic oligist, showing the ordinary rhombic crystalisation of that mineral, but the crystals are always very small. The fourth variety is very rarely met with, in the shape of little rhombic blades one and a half millimetres long, of a blood red colour, and more or less transparent. The fifth variety is that of octahedric crystals of magnetic oxide which have been found mixed with the former varieties and in rather larger crystals.

These crystals are usually soiled by a little sesquichloride of iron which oozes from the crusts by deliquescence, unless they have been thoroughly washed by rain, as happened for some specimens in my possession which never showed any deliquescence.

The celebrated chemist Mitscherlich sought to explain the production of this volatilised oligist, by assuming that it is due to the sublimation of *chloride of iron* which is afterwards converted into oxide, &c., and this is to a certain extent true.

But we may ask whence comes the *chloride of iron?* It is not probable that there exist deposits or lakes of this compound in the depths of volcanoes! The production of sublimed oligist is easily explained by the following experiment which I have recently made:—

At the bottom of a Hessian crucible a layer of chloride of ammonium is placed, and upon this a layer of ordinary red hematite (oligist), both substances being finely pulverised. Into this crucible a second crucible is thrust, so as to repose firmly upon the layer of oxide of iron, the crucibles being chosen of such a form that the sides of



a, oxide of iron; *b*, sal-ammonia.

each are nearly in contact (see figure). This little apparatus is then half buried in the fire of a forge, where it remains about three-quarters of an hour, and is then allowed to cool. On separating the crucibles, the outside of the inner one and the inside of the exterior one are found coated with the sublimed oligist in question, quite similar to that of Vesuvius. Along the sides of the crucibles may sometimes be remarked some of the varieties of oligist above mentioned.

It is therefore, in my opinion, by the passage of volatile alkaline chlorides (such as those of ammonium, sodium and potassium) through or along deposits of red oxide of iron that the sublimed oligist of Vesuvius is produced. These alkaline chlorides are always to be met with at Vesuvius, they are invaribly present in the different incrustations and efflorescences.

The magnetic octahedric crystals have been evidently produced by the influence of a higher temperature; however, they are very frequently present, though often invisible, among the crystalline grains of oligist. When the crusts of the latter are pulverized a magnet will separate them. This fact, together with the difficulty with which the oligist itself dissolves in hydrochloric acid, is another proof of the high temperature at which it has been produced in nature, and which is also required to produce it artifically.

* Read before the British Association for the advancement of Science. Birmingham, 1865.

DESULPHURISING ORES.—Dr. Minthorn, of New York, claims the intervening chamber or diaphragm containing iron borings or equivalent material, whether stationary or rotary, between a fire chamber and an ore receptacle, for the purposes above specified.—2. He claims in connection with the above the annular or equivalent hollow forms of the said diaphragm.—3. He claims the perforated cones or hollow projections in the chamber or diaphragm.—4. He claims the inclined plates, forming a tunnel-bottomed furnace for collecting the disintegrated material, arranged relatively to the ore chamber, and to the other parts.—5. He claims the arrangement of the dishing grate or basket relatively to the annular or hollow diaphragm, so as to facilitate the presentation of a thicker stratum of the ore near the centre, where the currents of gases and steam strike directly, than near the edges where they strike with less force.—6. He claims the arrangement of the passages and dampers for changing the dissection of the heat and gases.

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IMPROVED CHRONOMETER GOVERNOR AND BALANCED THROTTLE.

IN this engraving we have a view of a new governor, designed by Mr. John Tremper, of Philadelphia, and intended to economise fuel, keep the engine under perfect control, render any speed attainable at a moment's notice, and thereby improve the value of the steam engine as an economical motor.

It is notorious that of all good servants steam engines are the hardest used. They are not only badly designed, built, and run, but they are placed in all sorts of exposed situations, and neglected so much, in various ways, that it is no wonder that it takes 12 pounds of coal to produce a horse-power on an average, when one-sixth of that amount ought to suffice.

This mechanism governs the engine by cutting off the steam at the point required to do the work. It admits just as much steam at every stroke of the piston as may be required, and in that way maintains a constant and regular action.

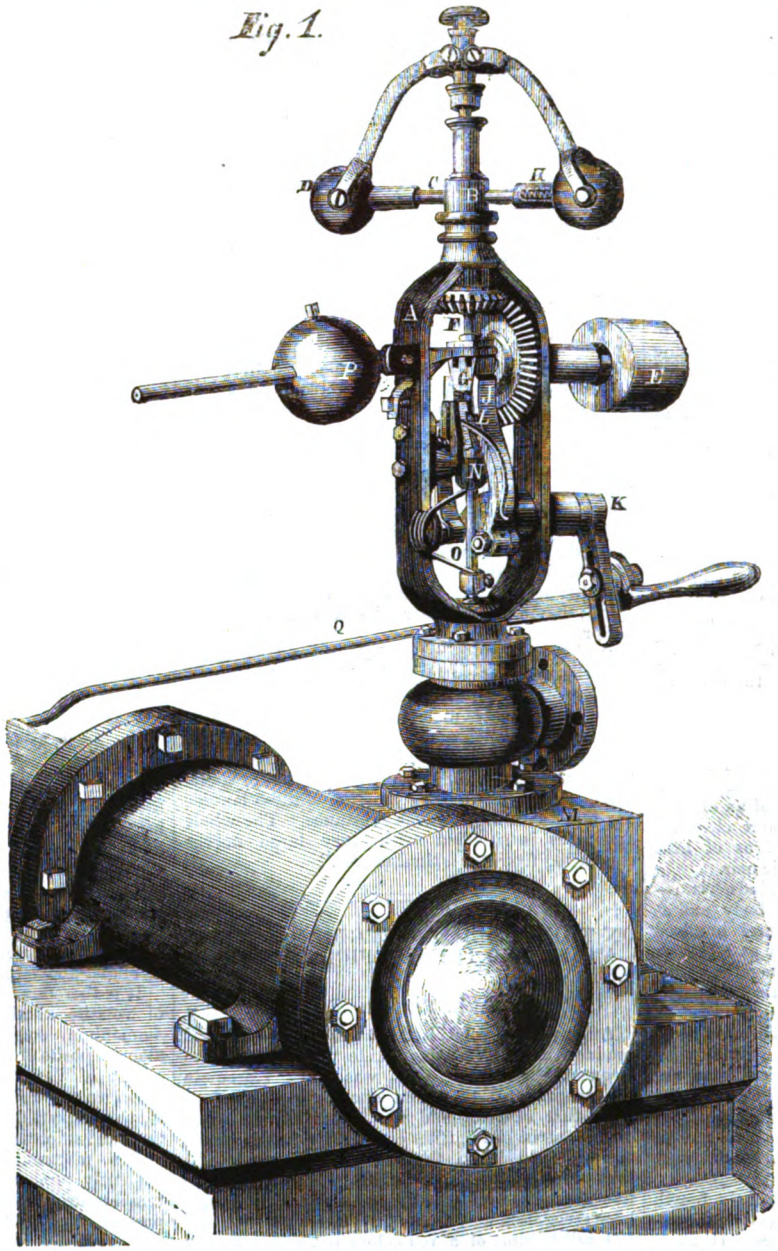
In the engraving A represents a frame carrying an upright spindle B, in which the arms of the governor are fixed.

This governor is peculiar in construction, as can be seen at a glance. The balls, D, are fitted to the arms, C, and slide thereon, the arms being revolved by the bevel gears and pulley, E. When revolved, the balls fly out, and, in doing so, depress the stem, F, which connects to the wedge, G, for a purpose described below. Any fluctuation in the speed of the engine, whether above or below, that the governor is set to, is, therefore, instantly corrected by the movement of the balls, they being thrown out by centrifugal force, and returned to their positions by the centripetal action of the springs shown in the broken-out portion of the shank H.

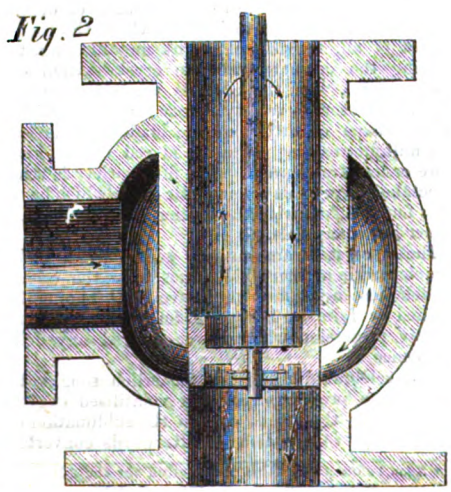
When the wedge before alluded to is depressed it acts on two jaws, J, which are connected to a rock shaft, K. These arms have steel bars, L, let into them which catch on the head of the valve stem and raise it, as clearly shown by the engraving. The arms receive motion from the rock shaft before mentioned, and are, therefore, raised vertically, carrying the valve stem and valve with them, until they strike the wedge, G, up which they continue to rise until the valve below is released from them, when it falls and shuts off the steam in the steam chest M; from this chest it goes to the cylinder through the valve, as usual.

The throttle valve is shown in Fig. 2, and it will be seen that it has no seat, and that, consequently, there is no jar or concussion at every stroke, as in some machines. The valve is stopped, so that it shuts at the right place by a bracket N. The socket on the head of the valve stem brings up on a cork facing in this bracket. The spring O is to seat the valve quickly. As it is a balanced valve, it needs some aid of this kind to shut quickly and prevent wiredrawing the steam.

The speed of the engine is regulated by shifting the ball, P, on the lever. This increases the labour on the balls by adding to the weight to be overcome by the centrifugal force, so that the engine runs faster to make the force greater. The cut-off valve is operated by an eccentric on the shaft, and a rod, Q, as shown.



TREMPER'S CHRONOMETER AND BALANCED THROTTLE.



The governor will act just as well without this weight, and it is only applied where a variable speed is required. At whatever velocity it is set to give, the governor will maintain it regularly for all time. The cut-off jaws, being attached below the centre of the rock shaft, have a tendency to fall in toward the valve-stem socket, so that they always hold well without any danger of slipping, and the hard-steel edge in both the jaws and socket enable them to wear a long time. The engine can be stopped from any part of the building if necessary, and the governor can be applied to any engine, new or old.

It is stated that hundreds are now in use in Philadelphia and vicinity, and giving entire satisfaction. We are of opinion that the governor will effect a saving in fuel on engines without cut-offs, and that it will act properly when well taken care of.

It has been patented by John Tremper, of No. 316, North Third-street, Philadelphia, U.S.

SHOT-MAKING IN NEW YORK.

One of the most interesting manufactures which the busy city of New York presents to the inquiring mind is that of shot-making, of which most people have no other idea than an indistinct one of a huge and lofty tower through which melted lead falls into a water-pit at the bottom.

The brick tower of the New York Lead Company, in Centre Street, is something less than 200 feet in height, and about 60 or 70 in circumference. At the bottom is a well of cold water, and the summit is entirely devoted to the melting machinery—the pan or sieve through which the shot falls being situated in the centre and quite small, say a foot and a half in diameter. The lead is conveyed to the summit in pigs or bars, and there melted. Before being poured into the pan it is slightly mixed into crude arsenic, to prevent oxydation. Much of the lead, in passing through the holes of the sieve, comes out in elongated drops, in the same way as the dripping of water, thus causing imperfect shot, which are increased by the soft shot touching each other in falling, and adhering.

Standing on the ground-floor of the tower, the shot can be seen and heard falling and hissing into the well beneath, the water of which is splashed up high as it receives the driving, seething rain.

From the well the shot is transferred to a drying machine, lightly rolled by hot flannel rollers, and, after being thoroughly dry, it passes through the next process, which separates the imperfect from the perfect shot. This consists of a long smooth, wooden inclined plane, divided into regular ledges, each one a little lower than its predecessor, with a slight break or open space of about half an inch between. The round, perfect shot, in rolling down this plane, leap the openings, while the imperfect, not having the same momentum, fall through, and are gathered up to be re-melted.

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The next process is separating the different sizes. This is done by a sort of chest of drawers, the top of each drawer being covered by a sieve—the coarser at the top, and thence becoming finer toward the bottom. This cabinet is kept in a swinging motion to and fro by machinery, thus shaking the mixed shot, which is poured in at the top, from drawer to drawer, until all the different sizes are duly assorted into separate drawers.

The shot has now a dull, dusty colour, the finer grades appearing more like sand or black meal than a mass of separate and uniform globules; and the next operation is to polish. This is performed by putting it into revolving cylinders, with black lead, and from which the shot is at length projected, bright and shining as beads of glass. It is next put in bags, and is ready for shipment.

The shot business is now very brisk. More is shipped at the present time than for a number of years past. During the war a large business was done in Minie balls, or slugs, hollowed at the but. The trade is now almost altogether in shot, not including the three sizes of buck-shot, which are moulded like bullets.

There are four shot towers in New York and vicinity, viz.:—The New York Lead Co., Centre-street; Tatham & Brother, Beekman street; T. O. Leroy, Walter-street, and McCullough's Lead Co., Staten Island. The capacity of all these works is very nearly equal, that of the former being from ten to fifteen thousand pounds of shot per day—or a total of forty to fifty thousand pounds.

COMBINED SCREW LATHE AND MILLING MACHINE.

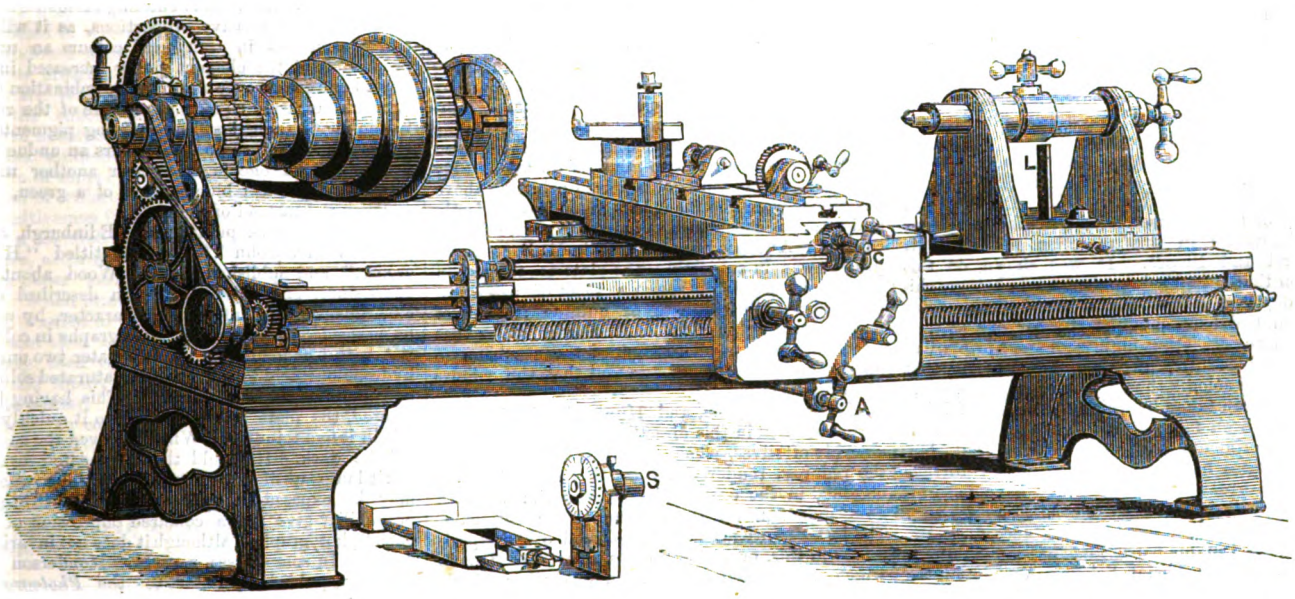
A NOTICEABLE feature in modern American workshop machinery is the several uses to which the same tool can be applied. Time was when a lathe was merely a rude affair for making an object round, but it has been vastly improved upon by the efforts of ingenious men, and the different attachments which have been made to it render it one of the most indispensable tools.

The lathe here illustrated is a strong and well-designed machine; it swings 28 inches, and is a screw-cutting and milling machine combined; besides this it can be used for a variety of purposes, such as boring, that other lathes are not well adapted to.

A novel feature in this lathe is the addition of a cross-feed. This is a most important advantage on some kinds of work, as it is done more expeditiously than by hand, and of a much better quality. The arrangement can be seen in the engraving, where the feed screw shaft has a small pinion cut on it, in which a worm runs; the worm is driven by a small counter shaft and belt on the shears near the cone pulleys. This arrangement can be easily detached and thrown out of gear by removing the box, D, and releasing the thumb screw, C. The carriage and slide rest is raised or lowered so as to adjust work thereon by the handle, A, which works a vertical screw by bevel gears on the back of the lathe.

The variety of work for which this lathe is adapted is as follows:—It may be used as a common turning and screw-cutting engine lathe, with the advantage of a cross-feed, which is not usually obtained with lathes of this size. It may be used as a boring engine. The work can be easily fastened to the table, and afterwards adjusted perpendicularly or laterally with the same facility as in the improved boring engines now in use in the best shops. It is eminently adapted for use as a heavy milling machine. One of its merits, in this respect, is the facility with which it can be adjusted perpendicularly, enabling the workman to make two or more cuts upon any piece and then return the lathe to exactly its first position, ready for the first cut on another piece by simply turning one handle. The machines have been used during the past year for working pieces of wrought iron and steel of larger dimensions than are commonly worked in milling machines, doing the work quicker and getting a smoother surface than by the planer. It may be used as a gear cutter for any size within its range, for the making of rimmers and cutters, fluting of taps, slabbing of bolt heads, &c. For cutting bevel gears the spindle, S, has a joint attached capable of adjustment at any angle.

Patented by L. D. Fay, Worcester, Mass., U.S.



PHOTOGRAPHING THE COLOURS OF NATURE—A BIT OF CHAT.

SCIENCE is the very heaven of quackery. In nothing else can an ignorant pretender so safely display his want of knowledge with so little fear of detection or exposure. By the aid of a trifling—very trifling—knowledge of sundry technical terms and symbols, together with the frequent use or abuse of them on every available occasion, what is called a scientific reputation may be obtained as cheaply as if it were a reputation for turning a handmill, or performing some childishly simple conjuring trick. Of all quacks—political, artistic, religious, &c., and Heaven knows we have no lack of such—the quacks of science are most numerous, and stand foremost for fearless impudence and true bigotry. Other false pretenders may be haunted by *some* wholesome dread of exposure, and be less noisy and pretentious in consequence, but no such restraining influence affects the scientific quack. He knows, no one better, that science is not popular in the every-day world of life. That, therefore, any absurdity, provided it be rendered elaborate, complex, and mysterious, by the bountiful use of scientific phraseology, will be received with that profound awe and intense admiration which, under ordinary circumstances, every calf may obtain who is brazen enough to assume the lion's skin of science. Should some real student philosopher attempt to strip him of so noble a disguise, and show his real nature, the quack meets his opponent with unblushing confidence. By belabouring him with a meaningless bewildering jumble of accidental facts and falsehoods, delivered with the overbearing loudness and vulgarity characteristic of his class, he speedily induces the real man of science to abandon so useless and unsatisfactory a contest. Then, with what lusty vigour your quack crows aloud over what those who know nothing whatever of science suppose to be a well won victory!

If it were our purpose to dwell on this theme, we could point out a crowd of illustrations demonstrating the truth of the above statements, and show readily how in the earliest dawnings of almost every great scientific discovery, when the coming wonders loomed forth, but faintly, perhaps, in the imaginations of their great discoverers, these scientific quacks were first and loudest in the scorn and ridicule with which they strove to overwhelm them. Fully capable of grasping simple facts, perfectly competent to recognize four as twice two, and very proud indeed of such learned accomplishments, they could not realize "the fairy tales of science" until they were demonstrated to their much-belauded "common sense" through the medium of "facts" or "figures." To soar into the realms of fancy and bring from that land of dreams and aerial imaginings the seedlings destined to grow into discoveries, working mighty revolutions in art, in science, and in social life, would seem to them the wildest piece of stupidity conceivable. And yet it was in no other than these regions of endless suggestions that Daguerre the artist—a member of the French and Roman Academies—first found that idea to which we owe Photography. A vague but not altogether formless fancy which had long been entertained (and may yet be found perfectly detailed in the pages of more than one ancient story-teller), sprang into his mind, and appealing to his artist-love of nature generated the long series of scientific experiments which at last resulted in the daguerreotype. So with Talbot, who, in his "Pencil of Nature"—the first book illustrated with photographs—tells us that it was while dwelling regretfully on the "fairy pictures" of Wollaston's Camera Lucida, as "creations of a moment destined as rapidly to fade away," that the idea occurred to him "how

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charming it would be if it were possible to cause these natural images to imprint themselves durably, and remain fixed upon the paper!" It was but a fancy then, but it became the Talbotype soon after. So with photography in natural colours. The dream of the imaginative to-day, it may yet be the commonplace unnoticed reality of some future and not far distant period. Ridiculed and sneered at in quasi-scientific societies—where quacks do mostly congregate—and in class journals with pretensions to scientific qualities, at once the loudest and the worst supported—there are great, and good, and true men now busy with this interesting problem of whom we need but name—M. Chevreul and Niepce de St. Victor, to show the folly of the Smiths, Browns, and Robinsons, who, in the aforesaid societies and journals, mock an idea which Sir John Herschel did not think unworthy of studious consideration and many valuable experiments.

At a meeting of the South London Photographic Society, held on the evening of the 14th ult., Mr. J. Trail Taylor, a modest but earnest and able student of photographic science, who in conjunction with Mr. George Dawson, edits our contemporary, The *British Journal of Photography*, read a short but interesting paper on our present subject. The discussion which it originated was the feeblest and poorest we have ever heard at the meetings of that body, clearly showing how strong a feeling of scepticism exists relative to the possibility of photographing natural colours, and how little influence the encouraging facts brought forward by Mr. Taylor had in destroying it.

Let us now briefly glance at these facts.

In 1853 the subject of photographing natural colours was brought before "The Photographic Society" of London, associated with the researches and discoveries in this direction made by M. Becquerel and Niepce. It was shown on this occasion that actual colours had been photographically depicted; that the colours of the solar spectrum had been obtained, ray for ray, as they existed naturally—that highly-coloured prints had been reproduced with all their colours, and that although the colours thus got were fugitive, some steps had been taken by which a prospect of fixing them had been fairly demonstrated. Since then other experiments have been carried out, but although these have not resulted in any further advance of great importance, they have been by no means valueless, and their conductors are very far from despairing of ultimate success. Mr. Taylor stated in his paper that in 1863, at a *conversazione* of the Social Science Association in Edinburgh, he was entrusted by Sir David Brewster with the exhibiting of a photograph of the solar spectrum, taken on a polished metal plate, we presume either by one of the gentlemen above mentioned or by their process, and which he exhibited. He said—"I had this picture in my possession for a fortnight, during which time it was freely exposed to the light of the sun. Sir David Brewster, too, assured me that the colours had undergone no change since the picture had come into his possession, although it had been freely exposed to the light." Describing the colours as "most decided, although they could not be designated as brilliant in colour," Mr. Taylor added that the unimpressed margin of the plate was of a red colour, the image was preserved in a miniature case, and expressed his regret that "amongst the thousands of scientific experimentalists which photography boasts, the number of those who have devoted time and attention to this branch" was, he feared, "under half a dozen."

Becquerel's experiments, first brought before the London Photographic Society, in 1853, as we have said, were first published originally in the *Comptes Rendus* of February 12th, 1849, in a report by Regnault and M. Chevreul, whose pre-eminently practical and scientific work on "The Laws of Contrast of Colour and their Applications" is so deservedly celebrated. M. Becquerel had observed that the red rays of the spectrum acted rapidly upon sensitive paper, which had been previously exposed to light, although they exercised little or no influence upon it before it had been thus exposed, and also discovered that in the first case the actual colours of the spectrum were obtained, even to the extent of the colours given by the less refracted rays. The method, however, which M. Becquerel found most satisfactory was the following:—After polishing a silver plate, it was attached to a small wire support, which held it with two hooks. Two of the wires thus used were joined at the upper end, put in communication with the positive pole of a galvanic battery, and plunged into a bath of hydrochloric acid and water. In this bath there was also placed a strip of platinum, communicating with the negative pole, which was moved rapidly backwards and forwards in a position a certain distance from the plate, and parallel to its surface. The plate took successively the colours of thin plates which were quite perceptible when the operating room was feebly illuminated. Commencing with the grey it passed in succession through the yellow, violet, blue, green, pale grey, rose, violet, and lastly the blue tints. The plate experimented upon was removed at the violet stage, attained after an immersion of about one minute, plunged into distilled water, dried with the aid of a spirit lamp applied from under the plate, which was slightly inclined as in the daguerreotype process, rubbed with soft cotton, to remove a species of fog upon its surface, and exposed to the rays of the spectrum, each of which registered itself very distinctly, the yellow ray being in this case least distinct, although quite discernable. M. Becquerel next found that by heating the plate before exposing it to the decomposed light it assumed a red tint and gave the colours with greater perfection. The required exposure was of about two minutes' duration. By the same process copies of coloured prints as above described were obtained, but much less perfectly and after a considerably longer exposure in the camera. Another improvement in M. Becquerel's process was in subjecting the plate to the action of sunlight passing through a sheet of paper impregnated with sulphate of quinine instead of merely heating it. Mr. J. R. Fowler states that he recently saw a photograph of the spectrum so obtained eighteen years ago and that the colours were bright still.

Herschel, Scheele, and Hunt, all of whom experimentalised in this direction, each observed that chloride of silver, when subjected to the action of the red ray, rendered its colour; and Herschel obtained in the course of some experiments with gum guiacum, all the colours of the spectrum. The latter gentleman also published other experiments in this, or rather in a similar direction, in which the action of light in producing single colours when acting in various degrees upon different substances sensitive to its influence was demonstrated. But the latter colours were of course more intimately connected with the characteristics of certain chemical compounds than with the colours of nature.

Perhaps the most perfect and promising of the photographs of natural colours are those of Niepce de St. Victor. Starting on the discovered basis that a plate of silver immersed in a solution of sulphate of copper and chloride of sodium and at the same time rendered magnetic by means of a battery, was sensitive to that peculiar action of the coloured rays by which they impress themselves upon certain surfaces, M. Niepce undertook some new experiments in this direction. He immersed the plate in a saturated bath of chlorine and water. Acting upon the impression that a chloride which gave a certain colour to flame might cause a similar coloured light to be more strongly impressed upon the surface with which it was associated, he added to this bath certain chlorides, each of which would communicate a certain colour to flame, and found when he had formed a bath containing all these elements in certain exact proportions, that, on a properly prepared plate, he could get all the colours with extreme brilliancy and clearness. He says, "in a doll dressed in stuffs of different colours and trimmed with gold and silver lace I have obtained all the colours, and what is still more extraordinary and more curious is, that the gold and silver are depicted with their metallic lustre, and that rock crystal, alabaster and porcelain are represented with the lustre which is natural to them." The greatest difficulty is that of obtaining many colours at the same time on the same plate. It is, however, possible, and I have frequently obtained this result. I have observed that bright colours are reproduced much more vividly and much quicker than dark ones, that is to say the nearer the colours approach to white the more rapidly are they produced."

An excellent photograph was obtained from this doll by the following process:—After the plate had been immersed in a solution of hyperclorite of sodium, having a specific gravity of 1·35, until it assumed a rose colour, it was covered with a solution of dextrine saturated with chloride of lead, then treated as before explained under sulphate of quinine and exposed. In connection with this process a new fact was noted, *viz.*, that certain compound colours—orange, violet and green—had no effect when artificially produced. M. Niepce found chloride of strontium added to the bath gave increased vigour to the action of colours containing red, that the chloride of calcium and uranium did the same for orange and its compounds, the pure solution of chlorine gave the yellow rays power, chloride of nickel the greens, the double chloride of copper and ammonia the blues, &c.; but a serious difficulty was found in mixing these substances in the proper relative proportions, as it will be easily seen how in compound colours an undue proportion of the element giving increased intensity to one colour over another in combination with it would entirely change the nature of the result in the photograph, just as in mixing pigments for the production of compound colours an undue preponderance of one pigment over another might give us a greenish blue instead of a green, or a purplish red instead of a purple.

In a small work published in Edinburgh, compiled by Mr. John Thompson, entitled "Heliocromy," and published by Mr. Wood about ten years since, Mr. Peter Henderson described some experiments of an interesting character, by which he succeeded in producing photographs in colours. "A bath was made composed of water two ounces, hydrochloric acid four drops, and saturated solution of common salt four drops."* This having been filtered, the plate was plunged into it quickly and left in it five minutes. When removed the surface will be dark. It should then be heated over a spirit lamp until it assumes a red colour, when it may be exposed in the camera and will in all probability give you a coloured impression of the object photographed, although it does not invariably do so. In some cases, says Mr. Henderson in a recently published letter to the *Photographic News*, "the proof would be a perfectly coloured copy of the original; at another in pure light and shade; and then again it would be a negative, and both without the slightest tinge of colour, although the manipulation was apparently identical with that which produced the coloured specimen.

But so far we have been speaking of silver plates. Photographs in colours have been obtained on paper, however, but not in the same degree of perfection. Paper washed with nitrate of silver and afterwards with fluate of soda will give the blue green and yellow of the spectrum. Paper prepared with ammonia, nitrate of silver (oxide of silver dissolved in a solution of nitrate of ammonia) will also retain natural colours, and by using a bath of chloride of barium and nitrate of silver, with a wash of iodine afterwards applied, the colours are secured with greater intensity, although they are then of a more erratic character.

Other experiments and their results have been described at various times, but we have not space for an account of them. It must be evident from what we have already stated that the crowning beauty of photographic colour has yet to be won. That the more successful but imperfect processes of which we have now briefly spoken, although affording tantalising glimpses of the possibility of photographing colour, must convince even the boldest and most able experimentalist of the insufficiency of our present knowledge of that most subtle element, light. Whether the reproduction of colour is due to some mechanical alteration

* We here quote Mr. Taylor.

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effected in the surface of the paper, or to chemical decomposition, or to both combined, or to neither, is not altogether clear, and although certain results may definitely follow certain discovered causes more or less easily created, yet until we can boast a much clearer knowledge of all the principles concerned than we now have, the discovery of a means of photographing colours is problematical.

At the meeting at which Mr. Taylor read his paper one of the vice-presidents of the society, Mr. A. H. Wall, stated that a cheap and exceedingly expeditious method of obtaining and multiplying photographs in colours would probably be found in painting the negative with transparent colours on paper rendered sensitive to the coloured rays, so as to retain the colours of the negative in the print, and that, by way of encouragement to those who were inclined to experimentalize in this direction, he might suggest the possibility of substituting photographs thus, "printed in colours;" for the coloured illustrations to books now obtained each one from numerous stones, plates, or blocks, at a great expense, and with comparitively unsatisfactory effects from the difficulties met with in the registering and printing.

Since that suggestion was made it has been announced in a letter from Paris that M. Poitevin has produced photographs in colours on paper by a simple process, which is identical with that of which Mr. Wall spoke. The paper used is prepared with the subchloride of silver, over which is brushed a solution composed of equal parts of saturated solution of bichromate of potash, saturated solution of copper and a twenty grain to the ounce solution of chloride of potassium. It will retain its sensitiveness for several days. This is exposed under a coloured print or drawing for five or ten minutes, according to the light and the character of the paper used as a negative in the ordinary way. When printed it is taken from the printing frame, washed in water, acidulated with chromic acid, and then with water containing bichloride of mercury, then with a weak solution of nitrate of lead, and finally in distilled water to remove all soluble matter. But these pictures will at present not bear the continued action of light, although M. Poitevin, we believe, is sanguine of soon fixing them permanently.

We have by no means exhausted our subject, but we have trespassed rather too largely on the space allotted to us, and for the present must say farewell.

CUTTING SCREWS BY CHANGE WHEELS.

I BELIEVE the subjoined is a new method of viewing this question; it is simple, and when one or two expressions are understood, is very handy and intelligible.

Because 3 times 4 are, or is, 12, 3 and 4 are called factors, or makers of 12; in the same way 2, 8, and 4, are factors of 16.

Because 5 times 2 are 10, 5 times 3 are 15, and so on, the numbers 10, 15, 20, 25, &c., being obtained by multiplication are called multiples, in the same way 24, 48, 72, are multiples of either 2, 3, 4, 6, 8, 12, or 24.

A set of change wheels, as generally made, runs by fives from 20 to 120, thus 20, 25, 30, 35, 40, 45, 50, 55, 60 (two of this) 65, 70, and so on; in fewer words, the multiples of 5 between 20 and 120 inclusive.

Four threads per inch being given on the leading screw, and, for example, $5\frac{3}{4}$ being required for the screw to be cut, proceed thus:—

1. Place this relation (*ratio* is the Latin term) down thus, $\frac{4}{5\frac{3}{4}}$. Don't think of this as a fraction, but merely as the relation which 4 has to $5\frac{3}{4}$.

2. Set those down in their lowest names, quarters in our example, thus $\frac{16}{23}$.

3. Set these down as split into factors, thus—

$$\frac{4 \times 4}{11\frac{1}{2} \times 2}$$

4. Multiply each pair of these (*i. e.*, 4 and $11\frac{1}{2}$, and then 4 and 2) by 5 or such a multiple of 5 that will suit the cogs in your wheels. Thus, using 10 as the multiplier for the first pair, and 15 for the second, we obtain $\frac{40}{115}\ \frac{60}{30}$, or using 30 for the second pair $\frac{40}{115}\ \frac{120}{60}$. Here notice that $\frac{4}{2}$ (this is the relation of 4 to 2 and nothing else) is the same as $\frac{2}{1}$, or the upper twice the lower, and for this cause you can use for the second pair $\frac{40}{20}$ if you have two 40's. $\frac{50}{25}\ \frac{60}{30}\ \frac{70}{35}$ and so on; hereby gaining plenty of room for choice which worked out tables cannot give.

The wheels being thus, $\frac{40}{115}\ \frac{60}{30}$, you can place the 40 on the mandril, let it work or gear into the 115, to this last couple the 60, and let it work in the 30 on the leading screw.

Had we taken our ratio (relation) thus, $\frac{4}{5\frac{3}{4}} = \frac{16}{23} = \frac{8 \times 2}{11\frac{1}{2} \times 2}$, we should have seen that 80 and 115 would answer the purpose, and then insert one or two dummies to change the direction, or make them reach. This would give us four shapes (1) $\frac{80}{\text{dummy}}\ \frac{\text{dummy}}{115}$; (2) $\frac{\text{dummy}}{\text{dummy}}\ \frac{80}{115}$, where the two dummies will be two 60's; (3) 80 to drive dummy, and it to drive 115 all in the same plane, not by pairs; (4) dummy to drive 80, and it to drive 115, as last.

Not to be tedious, take other examples:—

$\frac{4}{17} = \frac{4 \times 1}{8\frac{1}{2}\ 2} = \frac{40}{85}\ \frac{60}{120}$, where 85 and 60 are coupled firmly together, or $\frac{40}{120}\ \frac{60}{85}$, where 120 and 60 are coupled. $\frac{4}{21} = \frac{1 \times 4}{3 \times 7} = \frac{40}{70}$

$\frac{30}{90}$ or $\frac{2 \times 2}{3 \times 7} = \frac{20}{70} = \frac{80}{120} = \frac{4}{22\frac{1}{2}} = \frac{4 \times 1}{6\frac{1}{2} \times 6\frac{1}{2}} = \frac{40}{65} = \frac{20}{130}$.

HENRY HURST.

AN OLD PHILOSOPHER.

No. IV.

The expedient recorded in my last* gave the mode of determining the magnetic forces exercised upon iron at various distances from each other; and the extract concluded by stating that "in whatever way the magnet be turned, while continuing to be attached to the beam, it always approaches the iron." This experiment proves that one magnet acts not only upon another magnet, but also upon iron. Nor, says our philosopher, ought this to excite our surprise; for the magnet is only a stone consisting of good iron together with an intermixture of earthy parts. The stone derives its virtue not merely from its composition of earth, but from its possession both of earth and iron; for this reason its forces are the stronger in proportion to its greater degree of iron and of weight. That the particles of iron confer a force upon the stone was demonstrated by Swedenborg from experiment: he imbedded a piece of iron in stone, which remained in that position for several years, the parts corroded with rust permeating the stone, when the stone became magnetic. De la Hire (*l'Hist. de l'Acad. Roy.*, *Aug.* 1705) observed the same: he enclosed a piece of wire in a stone, and at the end of ten years the wire had corroded and the stone become a true magnet. "The iron, therefore, which is in the magnet exercises its power of attraction in connection with the earth which is mixed up with it; if, therefore, this should act upon the iron parts which constitute another magnet, it is not to be wondered at if it should act also upon pure iron; nay, possibly even upon those bodies which are possessed of no iron, but have only the same earthy attractive matter. For it is in this way that it acts upon certain plants; upon burnt bricks of an exceedingly red colour, as Cabæus has remarked (book I., ch. xvii., p. 63); upon the *caput mortuum* (calcothar) of vitriol; upon the shining and black dust supplied by Indian sand, and which never contracts a red colour; upon the black dust which remains after the distillation of linseed oil and oil of turpentine; upon the pomegranate; upon any precious stone, provided it be of a deep colour, according to Boyle; upon the stone of Lough Neagh calcinated, as is observed by Molyneux in *Phil. Trans*, No. 166; also upon the impurities of glass, according to Helmont." Hence it would follow that Pliny (and others) is in error when he says that iron is the only kind of matter which receives the forces of the loadstone.

Inasmuch, however, as all action is equal to reaction, it is not possible for the magnet to act upon iron, unless the iron act reciprocally upon the magnet, and therefore approaches the magnet in the same manner as the magnet approaches the iron. Swedenborg, to confirm this experiment, suspended a magnet from the end of a long string attached to the beam of a balance, and produced an equilibrium by placing a weight in the opposite side. He then suspended a mass of iron, of the same gravity with the magnet, from another beam by four strings, distant one from the other so that the magnet and the iron were almost in the same perpendicular line; and in this case he produced equilibrium. So soon as the two were brought near enough to operate on each other the iron approached towards the magnet and the magnet reciprocally as much toward the iron. Hence, in order that the two might remain separate, it was requisite to place a greater weight in the scale at the end opposite to the beam from which the magnet was suspended; by which means the magnet was raised; it was next requisite to place upon the iron, with great nicety, an equal quantity of weight by which it should be proportionably depressed, and as it were pulled away from the magnet. This being done an equilibrium resulted; whence it is evident that the action of the magnet upon the iron is equal to the reaction of the iron upon the magnet. This is exemplified in another manner. Place the magnet and the iron each in a little boat, and let them float on plenty of water: each will approach the other with an equal impetus, and mutually meet at the middle point between them. At this point of our readings, our friend Stalagmite said he was beginning to be of opinion that something was known of the magnet in former times; but he was cried down by the rest, and I was asked to proceed, and show how the operation of the iron upon the magnet could be reduced to calculation. To effect this my philosopher took a mass of iron (in form a parallelopepedon) the base of which was 224 lines of an inch square; its length $5\frac{1}{2}$ Rhenish inches. This mass, which had never touched a magnet, he placed upon a table so as to stand fixed. He next suspended a magnet (same form) from a rope annexed to the beam of a balance; so that the axis connecting each pole was perpendicular to the horizon, and passed through the axis of the iron. The magnet was let down at various distances successively from the iron, and an account

* The preceding three papers (on the "Attractive Forces of the Magnet and Iron") have appeared in the MIRROR OF SCIENCE and are at least interesting to those interested in magnetism, as showing the reasoning and experiments in the matter by Swedenborg, recorded by him a century and a quarter since. Our readers will well remember the short "life" of the philosopher contributed to our journal by "E. C.," who also contributes these extract-summaries.

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was then taken of the weight which it was requisite to place in the opposite scale to restore equilibrium, and which was always equal to the attractive forces of the magnet and the iron. The results are figured as under :—

Distances of Magnets in inches and lines.	Distances of Magnets in inches and lines.	Attractions measured by Apothecaries grains.	Attractions measured by Apothecaries grains.
3 ... 7	7	1	29
2 ... 11	6	1¼	32
2 ... 6	5	2	44
1 ... 7	4	6	54
1 ... 4½	3	10	72
11	2	14	69
10	1	16	116
9	0	17	180
8		21	

But here, I think, the matter may be left for this week. The experiments to follow—if you will kindly give them room—are of an interesting character, and include a record of some made in England at about the same time.

Photography.

I.

THIS art is now so popular that we think a few remarks on its practice may not be unacceptable to some of our readers. To embrace it thoroughly, some acquaintance with the sister sciences, optics and chemistry, is necessary. A love of beauty and an appreciation of character must be included. It is not necessary that a beginner should be learned in all the principles of manipulation, for these can be arrived at only by study and practice. The student of photography will find himself constantly seeking information from some collateral branch of science which will afford material for mental food, leading him onward simply but surely to a better knowledge of subjects which perhaps have previously been distasteful. The right management of the camera lenses will show that some knowledge of optics is advisable. The chemicals should not be trifled with as childish toys; their properties must be known, their combinations observed; poisons noted, and their antidotes stored up in the memory in case of need. But after all has been said and done the tyro may sally forth just to "take something," and return weary and disheartened, simply because he has not given his attention to the composition of a piece, or has not appreciated the outline of the picturesque.

* * * *

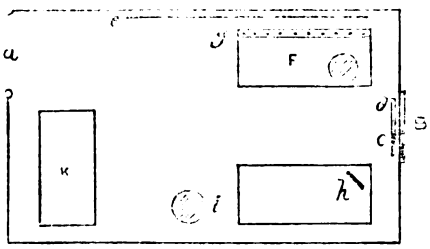
We propose, then, to offer for our readers' acceptance a few brief remarks, to assist him in his start and early progress, reminding him that to the attainment of knowledge in art and science there is no royal road. To succeed requires a deal of patience and perseverance, and we were about to add that this particular branch of art requires also a well filled purse, but we have wasted so much ourselves which might have been saved, that we hope our experience may be of use to other beginners. The design of these remarks will be to help, not to teach. We shall imagine that an inquiring friend is seated by our side, and for the sake of ease, the editorial "we" may possibly sink into a very humble but singular person.

II.

It will be very pleasant to take up your album and refer to scenes once visited, or to look on friends beloved and feel that the print you look at was from your own "press," to trace in your pictures how you progressed from first to last, and to feel with pardonable pride that when a "critic" says that's good you know that it is. But that is a stage to be arrived at only after some weeks of diligent labour—a reward for what has been done—an encouragement to go on and prosper. You desire to do something in photography, and you ask how you shall proceed, what it will cost, whether you will succeed? Success depends on yourself. Proceedings we leave for another chapter, but here I may remind you that as you take your common walks you may always be on the look out for bits of scenery subjects for taking even before you procure any apparatus. You may train the eye, and arrange that which at a future time you may be glad to take. The subject of light, its properties, the qualities of its rays, will make a pleasant study by a cheerful fireside. Get some work on photographic chemistry if you can; read and re-read it even before you have purchased any chemicals. When you have commenced active work you will have your plates by your side, so as to be able to observe their defects and perhaps detect their remedies.

III.

The larger the dark room the better, as you have more space to move about. Dust and light are the two great enemies. Have your room down stairs if possible—it will save your legs much labour, and your landlord, if you have one, the unpleasantness of requesting you to lay down a new floor. Place in it a strong table or two, and, in lieu of better appliances, a large washstand, with its accompaniments, omitting what you do not require. If the washstand is provided with a shelf, arrange on it those bottles which you will handle most frequently. On one of the tables may be placed your bath and silver solution bottles. If your room has a small window facing the north it will suit nicely, as you will not get the sun-light on it. Procure from a wholesale glazier's warehouse a piece of deep orange glass, size not particular; explain that you require it non-actinic when you purchase, as some specimens and colours are faulty; have it framed, and arrange it so as to be moveable, or slide on one side, that you may obtain plenty of fresh air. My room I prefer to arrange thus :—



A, door; B, window 18 inches square; C, D, collodion and developing glass; E, rod for suspending prepared papers; F, washstand; G, bottles; H, bath; I, receptacle for waste silver and washings; K, second table. The bottles may be arranged thus; the figures denote the number of fluid ounces contained in each :—

12.—Iron developer.	10.—Acetate soda.
6.—Pyrogallic intensifier.	18.—Hyposul soda.
6.—Iron intensifier.	1.—Nitric Acid.
4.—Silver solution.	2.—Bicarb—soda in solution.
8.—Cyanide—poison.	4.—Brightening solution.

Plenty of water will be constantly required. If you cannot procure distilled, boil rain water and filter it, but even for common purposes do not run short of soft water. The water-jug may be kept filled near the stand, the bottle on the table, together with a necessary receptacle and other immediate requirements; *eg*, ounce measure, levelling stand, &c.

N.B.—Clean and sweep out your room yourself, the oftener the better, and then you have no one to blame if anything goes wrong—a bottle broken for instance, or glasses mislaid. PLODDER.

ELECTRO-METALLURGY.

CHAPTER I.

Under this head we propose to give a series of chapters on the art of electrotyping, silvering, and gilding, in very simple language that all may understand.

By way of inducement to those who are ignorant of the process, let us assure them there is nothing difficult in it, and that it is not more expensive than many perfectly useless amusements. It requires but little space, not more time than most have at their command, and need not make the operator dirty.

An account of the discovery of this art would be interesting, but we propose to touch upon that from time to time, to start with practice.

We will suppose the reader knows nothing of the process, so that it would be useless to speak of batteries, precipitating troughs, &c., yet the first experiments may be made very readily and cheaply. Procure a piece of zinc, 3 inches by 6, by ⅛ thick, and one of No. 24 gauge copper same surface. One pound of sulphate of copper at about 6d. per pound, at any chemist's. Put about an ounce of the sulphate of copper into a jelly-pot or large glass, and dissolve it by pouring upon it nearly as much cold water as the glass will hold. Dip the zinc in this solution for half a minute, and observe when you withdraw it it is covered with a black substance, called a precipitate or deposit—which is copper.

Now put the copper plate into the solution by itself, on removing it you will see no change in its appearance. Now wash the zinc so as to remove all loose particles from it, and again put it in the solution, with the copper plate, but not touching it, in a few seconds it will be coated as before. Remove it and again wash off the precipitate and place it again in the solution, but this time let the zinc and copper touch outside the glass, but be separate in the solution. Remove both plates after about 30 minutes, and observe a nice bright coating of copper will be on the copper plate—none on the zinc.

The jelly-pot or glass will in future be called a "cell," the sulphate of copper "a salt," and when dissolved with water "a solution." The zinc is "the positive plate," the copper "the negative," and the whole together the "battery."

Now procure another jar and two pieces of copper, same size as before; mix in the jar a solution of sulphate of copper, same strength as before, and insert both strips of copper, let them stand about an inch apart, then join them by two wires to the positive and negative plates respectively of the battery. Let all thus arranged remain a few hours until time will permit you to examine it.

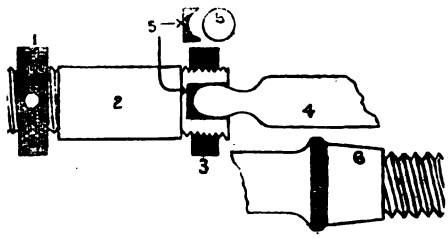
The second jar will, in future, be called the "precipitating trough," and both copper plates "electrodes."

We will suppose that the above experiment has been performed in the evening, and that you examine it next morning. On removing the electrodes you will find one black, the other covered with a bright deposit of copper, and that the bright one is joined to the positive plate of the battery "zinc," the black one to the negative "copper." On examining the plates in the battery, the negative will be covered with bright copper, similar to the electrodes and the zinc will be slightly eaten away, and the solution will be much lighter in colour. Thus, by the operation of depositing copper on the electrode, we have consumed the sulphate of copper solution in the battery, and dissolved some zinc. If the battery had lost all power to deposit, we should say it was exhausted. Let our readers perform these experiments carefully, and watch minutely the several changes, and in succeeding chapters we will lead them on to more amusing experiments.

(*To be continued*)

NEW CENTRE FOR LATHE.

OUR old friend, James Martin, the author of the "Screw Cutter's Guide," has forwarded us a sketch of a new back centre for the foot lathe, which we have thought worthy of reproduction in our columns. This centre we may state is his own contrivance, and has successfully stood many years' test on his own lathe, where it requires only half the usual power to drive it, compared with a lathe having the common centre, punch shape. It is well known that as soon as a drop of oil is put on when the lathe is running it flies off again, and



when the belt is put on it too often drags the mandril down the incline of the centre, and is constantly trying to jam the mandril into the collar; but with Mr. Martin's centre, so soon as a drop of oil is put on, with the lathe running, it instantly disappears into the working parts to perform the duty, and the quicker the mandril is driven its better is it oiled. No. 5 is a piece of steel, cupped out to fit the end of the mandril, so that it will run round with the mandril, or allow the mandril to run in it. Both ends of No. 2 are bored, one a little smaller than the other, so that if any extra wear takes place the mandril can be repaired, and fitted in the small hole, as the steel bolt only requires turning end for end, and must all be well hardened. The mandril must be

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turned to fit the hole tight, so that when it is hardened it will require grinding in with fine emery, until it runs easy, Nos. 1 and 3 show the wo jam-nuts, with holes in to screw them up by. No. 4 shows end of mandril- No. 6 shows the best form of shape and taper for foot lathes. and Mr. Martin recommends readers never to make a collar more than ⅛ in. or ¾ in. bearing for the mandril to run in.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

INSULATION.

Sir,—In No. 39 there is a note signed Veritas, warning your correspondents against wasting their endeavours to insulate magnetism. He asserts that it is positively impossible, as proved by his failures in a long series of experiments.

Strange enough, you tack on a line, stating him to be the patentee of a method of insulating the compass needle By insulation, I understand stopping the current of the magnetic fluid towards bodies capable of receiving it.

Now, though a tyro, I beg most respectfully to differ from Veritas, or ground my conviction of its impossibility from his failures. The idea violates no established law, and is, therefore, not unreasonable, more especially as we see it so completely accomplished in the sister sciences of electricity and electro-magnetism.

I prefer still to form an hypothesis, and work it out inductively, and if my experiments show that my reasoning is wrong, I console myself by knowing that if I clearly learn the cause of error, I am being led more surely in the path of truth. R. W. WILLIS.

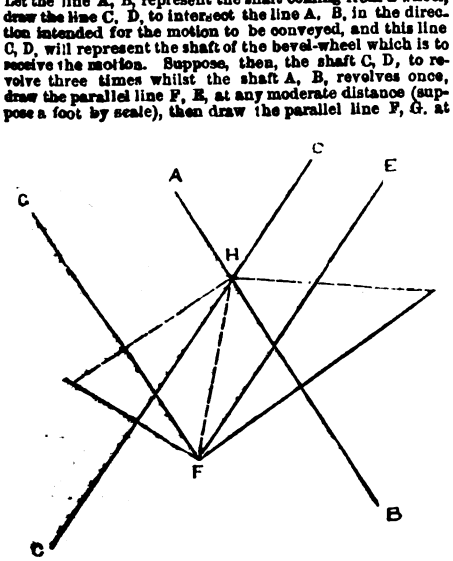
TELESCOPE.

Sir,—I find in No. 38 of THE ENGLISH MECHANIC, a description by Mr. McGurk of how to make a cheap telescope. Would your correspondent inform me how to make a terrestial telescope the same size he describes, how many lenses it would require, of what shape they should be, what distance the lenses should be apart from each other, and the probable cost of each lense?

Perhaps Mr. McGurk would tell me how to grind and polish glass for lenses? Would the paper that forms the tube require to be pasted with any particular kind of paste, or will the kind that paperhangers use answer the purpose? A. M.

BEVEL WHEELS.

Sir,—It is now four weeks since a correspondent asked the way to strike out a pair of bevel wheels, and, up to the present, I have not seen any answer. The following is the method of finding the taper or bevel for any line or angle. Let the line A, B, represent the shaft coming from a wheel, draw the line C, D, to intersect the line A, B, in the direction intended for the motion to be conveyed, and this line C, D, will represent the shaft of the bevel-wheel which is to receive the motion. Suppose, then, the shaft C, D, to revolve three times whilst the shaft A, B, revolves once, draw the parallel line F, E, at any moderate distance (suppose a foot by scale), then draw the parallel line F, G. at



three feet distance, after which draw the dotted line F, H, through the intersection of the shafts A, B, and C, D. and, likewise through the intersection of the parallel line F, E, and F, G, to the point H, then F, H, will be the pitch line of two bevel whee s. J. S.

A TRICK OF THE TRADE.

Sir—The "tricks" of mechanics prove frequently of so much use that it is well as you suggested to have a number collected and published. Amongst others, I submit the following:—Finding it necessary to cut racks, pinions, semicircles, &c., very often with irregular or odd numbers of teeth per inch, to match other parts already made in mathematical instruments, I select an outside screw comb, the pitch of which is found to match the pattern teeth by trial; then, having the intended rack or wheel to be cut prepared, it is made fast in the vice or cemented down. The comb teeth are laid on one corner of the metal, when the comb top is gently struck so as to indent the teeth. The comb is then shifted along so as to leave several of the comb teeth in the first set of indentations, again it is struck, shifted, and so on.

These indentations may be deepened with a triangular pile if necessary, (better not, however). Next, a small circular saw is made, the edge of which is an exact copy of the spaces between the required teeth. But to save work there are only 8 teeth cut in the saw, 2 at every quarter of the circle, care being taken not to cut them deeper than the wheel teeth they are intended to cut. For wheels or arches there is a small sawing table with a stem fitting down into the lathe rest socket. From near the front to the back on the table top there is a piece of metal with a straight slit in it, sunk to the level; the slit is set opposite the saw, so as when a pin is put through the wheel centre, it drops into the slit, thus allowing of a motion to and from the saw and round the centre, which is given by hand. The indentations are easily guided to the saw, especially if the table top be set slightly below the lathe centre; and from the form and depth of the saw teeth, it can only cut the proper depth in the wheel which should be cut round, then turned upside down and repeated. For racks, &c., side guides are required on the table top.

GAMMA (Glasgow).

SCREW CUTTING.

Sir,—In answer to X. Y. Z. I have gear for cutting wood-screws and nuts at a very quick rate, and if any gentleman will call on me at an appointed hour after 6 p.m., I shall be happy to see them. My arrangement cuts the wood for the nuts, and bores and screws them; and it will turn and cut the screw. My address is No 19, Wilson-street, New Cross-road, Deptford, S.E.—JAMES MARTIN.

CLEANING AMERICAN CLOCKS WITH SODA.

Sir,—Some of your readers were doubtless amused some time since by seeing a paragraph in the papers headed "How to Clean American Clocks." I did as directed - boiled my clock some hours in caustic soda, washed copiously, hung on the jack, and dried quickly. The clock was an eleven shilling one, gone regularly for ten years, but lately taken to stopping through clogging up of the pinions; it has since behaved itself well, gone regularly. and keeps good time. The treatment is peculiarly applicable to these clocks, for, owing to their low price, our professional clock cleaners do not care to meddle with them. CHEMICUS.

CEMENT FOR AQUARIA.

Sir,—I would be obliged, and, no doubt, others of your readers, if you would give us the proper quantities of glue, resin, oil, and whiting required for a good composition to ornament frames or other inside decoration. I find by putting them in by chance they are apt to crack up and cost much labour to refix.

I have seen many inquiries in your paper for a good cement for aquariums. I have tried fifty different ones, and find the best composition is, one part common pitch, one-half part gutta-percha; they can be melted in a little turpentine. To make it work easier, there must be no coal oil in the turpentine, or the pitch will soften and be destroyed; a rascally druggist made me lose several pounds worth of gutta-percha in that way. You will find this mixture gives a little with the material that the tank is made of, as the changes of heat and cold affect it; and it will adhere to glass, wood, or iron. E. BRUCE.

[The proportions are one pound glue, one half pound linseed oil, two pounds whiting. Stir well while melting, and let it cool gradually on a stone covered with powdered whiting; heat it well again until it is tough and firm; cover with a damp cloth when not in use.—ED.]

DISC ENGINE.

Sir,—I have in my possession a disc engine, on the side of it there is a brass plate engraved as follows:—

"Birmingham Disc Iron Company,
Davis & Co., Patentees,
2-horse High Pressure."

I should like to get some information respecting it, as I think there are some parts wanting.

If any of your numerous readers could inform me whether there are any of the engines at work, I should then be able so know whether they are of any use.

CHAS. W. BRADLEY.

ELECTROTYPING.

Sir,—I am sorry Mr. McGurk could find nothing new to offer your readers as a Christmas present.

The process about which he seeks to enlighten us is described and illustrated in Watt's "Electro Metallurgy," p. 15, published by Weale in 1860, price 1s. 6d.

Mr. McGurk, however, has made one grave omission, which, with your leave, I will supply from the excellent little work above referred to.

Mr. Watt writes:—"Care must be taken that the end of the conducting wire attached to the mould, and that part of the composition near it receive a good coating of the plumbago to insure a perfect connection between the wire and the plumbagoed surface."

Of course, without such connection all the batteries and concentrated solutions in the world would not deposit a particle of copper. W. J. F.

CYCLONES.

Sir,—The theory of cyclones has been remarkably modified of late years. They are no longer regarded as meteors, having origin in the torid zone, travelling westerly towards the region of tropical calms, then recurving, and advancing north-easterly towards the polar regions, where they spend themselves. They are now considered rather as the result of the appulse of polar and equatorial winds, acting upon a region of rarified air, about which, in their endency to compensate a diminished pressure of atmosphere, they create a gigantic whirlwind, the duration of which is limited to a few days, and a comparatively small portion of the earth's surface.

Supposing the air over a considerable extent of the earth's surface to become much reduced in weight by copious precipitation of aqueous vapour, and, secondly, by the latent heat given out by the vapour in its condensation; then I can understand that the normal aerial currents of the temperate zone could tend to restore the reduced pressure, and that, in consequence of the rate of rotation of the parallels of latitude being slower the nearer they are to the earth's pole, the polar current would go eastward, and the equatorial current westward, and thus they would act as a mechanical couple upon the area of lower pressure, and produce a whirlwind, which must have an invariable direction of rotation. But what I cannot understand is that the northern portion of the cyclone should continue to maintain, as meteorologists assert, the distinguishing features of a polar wind, viz, heavy, cold, and dry air.

It seems to me that the cyclone once formed, the area of low pressure must rapidly be filling up, and the passage of the polar wind to the south, and the equatorial to the northward, must soon restore equilibrium of pressure, temperature, and humidity; and that the pole-ward and equator-ward portions of the whirl, at each rotation, must exhibit less and less difference of these characteristics.

I would request you to invite the opinions of your readers who are versed in meteorological science upon this subject, and remain a sincere well-wisher of your enterprising journal. R. STRACHAN.

11, Offord-road, Barnsbury, N.

THE CHEMISTRY OF NATURE.

Sir,—In the third number of the MIRROR OF SCIENCE I find a lecture on the chemistry of nature, by G. F. Harrington, in which he gives to the world a somewhat novel, and certainly startling, theory of vision, teaching that so far from rays of light emitted and reflected being the means by which objects are seen, on the contrary, they have nothing to do with it at all—something he calls liberated power being the true agent. This theory he seeks to support by some experiments with the magic lantern and plane mirror. These experiments are true I grant, but the reasoning from them, which are most fallacious, must arise from ignorance of the laws of reflection of light from polished in contradistinction to that from rough surfaces. For the benefit of those of your readers who have not made optics a special study, I will just state the two. First, as to reflection from rough surfaces. If a body on which light falls be unpolished and opaque, a portion of the light enters into it for a small depth, and is there partially absorbed; the complimentary portion (that reflected) is scattered in all directions: the surface, therefore, becomes to that extent a source of light, but in consequence of a quantity of the incidental rays being absorbed, the composition of the reflected may be widely different from that of the incident light. This is the cause of the variety of colours that bodies display: for instance, when the blue rays are absorbed the body will appear orange, when green are absorbed red and so on. If the body be white none of the light is absorbed, all is reflected, but in consequence of its roughness, in every direction, as the roughness may be supposed to, and in fact does consist of a great number of projections and hollows, the sides and summits of which, pointing in every direction, will scatter the rays at every angle. This, of course, explains why a shadow picture thrown from a magic lantern upon a white, unpolished screen can be seen from any part of the room at the same time; and also why no image can be formed by reflection from a white unpolished surface, although that surface reflects all the rays that fall upon it.

But, when the body on which light falls is plane and polished, the rays which do not enter the body will, after reflection, instead of being scattered in every direction, as from a rough surface, diverge at only a certain determinate angle, which angle is found, by experiments made for the purpose, to be equal to the angle at which it falls on that surface. In other words, the angle of reflection is equal to the angle of incidence. In consequence of this law if any body be placed before a mirror the light which emanates from that body will appear, after reflection to proceed from a similarly situated point behind the mirror, and thus an image exactly similar to the body will be seen by looking at the mirror. This explains why a mirror being placed in the position of the magic lantern screen we only perceive an image of the illuminated nozzle of the lantern with the picture in it, at a distance behind the mirror equal to that of the lantern before it. Now the lantern, picture, and mirror being so arranged, if Mr. H. will place the white screen opposite to the mirror and a little above it so as not to intercept the rays from the lantern, he will perceive upon it a large illuminated image of the picture in the lantern, precisely as he would if the screen occupied the same position as the mirror, thus proving that the rays reflected from the mirror and those emitted from the lantern are precisely the same, the only difference being a change in direction. The fact of the image on the screen being obliterated by a candle is explained when we recollect, that it is but a shadow (a coloured one it is true, but still only a shadow) of the picture in the lantern, and we know how a shadow is invariably destroyed when a light is thrown upon it. If Mr. H. will try the effect of the lime light in the lantern he will find that the image on the screen will be almost as distinct in the presence of a candle as in the dark; thus following the law that the more intense the light the more intense the shadow it throws.

In the experiments with the two pieces of glass backed with white and black paint, Mr. H. entirely loses sight of the fact that it is neither reflection from the black nor the white that forms the image; for, according to the law of reflection, no rough surface can possibly reflect an image. On the contrary it is the polished surface of glass in both

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cases that forms it. Every piece of polished glass reflects a part of the rays falling upon it and transmits the rest—minus a small quantity absorbed. Now these transmitted rays, when the glass is backed with white, are all reflected according to the first law I have stated above, and as these rays are far greater in quantity than those reflected from the polished surface, they interfere with and almost overpower, the image formed by those rays, precisely as the candle obliterates the comparatively faint light of the magic lantern picture.

But, on the contrary, all the rays transmitted through the black backed glass are absorbed by the black backing, and, of course, do not interfere with the image formed by its polished surface, which shines out with far greater distinctness than the other, just as the magic lantern picture is brightest when there are no rays reflected upon it from surrounding objects—in other words, when the room is dark.

Mr. H. further states that when the mirror occupies the place of the screen before the magic lantern the small magic lantern slide negative image will appear clearly represented in the mirror. I entirely disagree with this. The only thing distinctly defined in the mirror is the illuminated nozzle of the lantern with the various coloured rays emerging from it; precisely the same appearance as the lantern itself displays when we look at it, and how could Mr. H. hope to obliterate this appearance except by putting out the lamp, inside the lantern, a feat not exactly performed by bringing in the room a lighted candle.

I must beg to apologise for trespassing so much on your valuable time and space, but I humbly hope the occasion justifies me, for as theory manufacturing is so fashionable now, to the great detriment of true science, it behoves every student, who has truth for his aim, to expose all that he can of these specious schemes that, under the guise of science, are in reality the greatest enemies to its progress.

J. M. MOSS.

OUR SUBSCRIBERS' NOTES AND QUERIES

PRESERVING.—Can any of your readers inform me how to preserve the skins and legs of animals, and how to polish horns and hoofs?—YOUTH.

VELOCITY OF RIVERS.—Can any reader inform me how o determine the velocity with which water runs in rivers?—GREENHOLME.

BATTERY.—Will some correspondent kindly inform me where I can obtain a succinct account of the thermal battery, as briefly lectured upon by Mr. King, of the Polytechnic?—J. K.

BIRD STUFFING.—Can any reader tell me, 1st, the ingredients used for curing the skin of birds for stuffing? 2nd, the ingredients used for cleansing the blood or dirt off the feathers?—AMATEUR BIRD STUFFER.

LENSES.—Will Mr. McGurk favour me by saying where the lenses can be had for the telescope that he speaks about, and the price per post to Manchester?—RULE BRITANNIA.

FORCE PUMP.—I want to supply a boiler with water by means of a force pump. The plunger is 2½ diameter, the well is a distance of 75 feet from the pump, and the water is 22 feet down the well. Will any reader tell me how to do it?—AQUA.

SOLDERING.—Will any kind reader give me information as to how the joints of watch cases are put on, and the kind of solder used?—WATHCASE.

MODEL STEAM BOAT.—Can any reader oblige me with plans for a steam-boiler for a model steamboat, the length 4 feet, width of beam 8 inches, depth beneath the deck 5 inches?—J. M.

SCREW CUTTING.—Will any reader engaged in screw-cutting on the slide lathe give me a plain and simple rule how to obtain the various sets of wheels, for various pitches of thread, for slide-lathes having various pitches of guide screw?—SLIDE LATHE.

CYLINDER.—Of what thickness should I make the cylinder of an hydrostatic press? The diameter of the ram 5½ inches, pressure 560 pounds per square inch?—AVONIAN.

SLIDE.—Can any correspondent furnish me with a drawing of slide for sliding governor balls? Also a receipt for varnishing water-colour drawings and tracing.—P. R.

PHOTOGRAPHIC.—Can any reader instruct me how to remedy a negative silver bath that has become saturated with organic matter or other impurities, and give me a good formula for making a negative bath suitable for quick or instantaneous portraiture? What quantity of sulphate of ammonia must be added in recovering pure silver from photographic residues (mentioned at page 12 of the *Mirror of Science*), or, how am I to know when there is sufficient added? I see one of your correspondents attribute the effect of seeing the image before developing to the vapour of ammonia. I once saw it quite distinct. It was in the month of March, 1865. I was quite surprised to see it, as my instruction book told me that there is not the least sign of an image visible until developed; but it was quite the reverse to what your correspondent says at page 30 of the *Mirror of Science*, as I had no ammonia in the room nor any other vapour that I know of, and the picture was rather under-exposed.—A. P.

REPLIES TO QUERIES.

DIFFERENTIAL GALVANOMETER.—Thanks to Plumbago and E. H. for their description of a differential galvanometer. I like the form mentioned by Plumbago best, but should feel obliged if E. H. could give me any rule for the length, thickness and form of needle, and length and thickness of the wires. I require to measure coils of wire of one mile to 500, and obtain the measurement in units of resistance; which unit can you recommend?—STUDENT.

In answer to Ardent Student, the experiment you name is a dangerous one to try. I never tried it in the precise form you name, but I can recommend a variation. Powder 4 grains chlorate of potash; 2 grains lump sugar, and 2 grains of sulphur, separately (carefully cleaning the mortar each time), and you will probably succeed. But I am sure the following, which is very similar, will.—In this case you can take 10 grains chlorate potash; five of lump sugar, and pound separately, and mix. If this be placed on the back of a plate, and one drop of sulphuric acid be dropped from a glass rod upon it, it will fire. Vary the proportion of sugar, and the mixture burns slower or faster.—ELECTRA.

SYPHON ACTION.—If E. H. has not yet expounded his problem in syphon action in No 39, I will more fully state the circumstances. I think I can explain the causes, as I have never met with a problem in hydraulics in my practice as a plumber but what I have succeeded in comprehending after a little thought. The facts stated by E. H. are in themselves in direct opposition to the principle of syphon action.—YOUNG IDEA.

VELOCIPEDE.—In reply to Mr. G. W. Walton on velocipedes; I have long seen the want of ratchets to the wheels for convenience in turning, but how does he propose to stop in going down hill, that is the difficulty I have always seen to the use of them?—J. E. PHILLIPS.

EARTH CURRENTS.—Thanks to Borealis, I have observed these earth currents upon many occasions, but I am anxious for a better knowledge of them, and I think in a publication like THE MECHANIC AND MIRROR OF SCIENCE electricians and astronomers combined, may compare notes and exchange observations that will bring the matter from its present obscurity. Taking one matter at a time, I would ask this question: At 10·45 p.m., Oct. 5th, 1865. I observed very strong earth currents, which lasted till 11·7 p.m. I measured their strength and direction on a common galvanometer in degrees.

No. 1.	112 miles N. W. direction from London	56°	positive to Lon.
„ 2.	114 „ „ „ „	58°	„ „
„ 3.	200 „ „ „ „	20°	„ „
„ 4.	60 „ North from London	10°	„ „
„ 5.	115 „ South West from London	2°	„ „

Why did I receive less from No. 3 than from 1 and 2?—Why less still on No. 4, and so little on No. 5?—AURORA.

ECCENTRIC CHUCK.—D. Hall asks the use of eccentric chuck. It is for cutting out such patterns as those on the back of engine turned cases of watches, any pattern in fact, that can be formed of circles arranged in concentric rings. The screw of this chuck withdraws or propels the object a certain distance from the axial line of mandril, a small slide rest, the zero division on which is true to the axis of the mandril, is used to cut the grooves. The tool in this rest is moved any fixed distance from the zero point; such distance is the radius of the circles which form one ring of ornamentation, the central line of the ring of circles is distant from the true centre of the object turned, just so much as the screw has thrust it out or pulled it in. The object can turn round on its own centre, and a click plate or worm-screw is provided for placing the circles a fixed distance from each other in the ring of ornamentation. The ring for oval work is not used in cutting eccentric patterns. To turn anything oval about two feet long, there are two methods open: 1. If back stock is used, rig up a prong chuck hung on gimbals, on the face of the oval chuck, such a prong would allow of the gliding action of the chuck; and the work would be oval at one end, and gradually turn to circular at the back centre. 2. Secure an oval rove (a plate proportioned as you think fit) either to the mandril or to a common chuck; against this, at the back let a rod, hinged to move horizontally, be pulled by a weight, and to this fasten the cross sliding piece of a slide rest, from which the screw has first been taken. This, and consequently the tool you cut with, can be pulled towards you by the weight above named or a spring. This will keep the rubber on the rod tight up to the rove, and if the rod is hinged just true with the back centre, the work will be as before oval at the chuck end, and circular at the back centre.—H. H.

DRILLING STEEL.—S. J. must let the steel be in the fire all night to soften it, before any tool will bore it. For small holes a bevil wheel drill is best, a blacksmith will tell him about large ones.—H. H.

ENAMEL ON WOOD.—Forward will find the best way to enamel wood to look like French polish, to be that adopted by the coach makers, particulars of which have been already published, I believe, in THE ENGLISH MECHANIC.—H. H.

CUTTING WOOD SCREWS.—X. Y. Z. asks for machines for cutting outside and inside screws in wood. Healy's chuck will answer his purpose if he has a lathe, and a screw box and tap if he has not.—H. H.

J. H. R.—Imprimis.—Do not attempt to make tracing paper if you want it for a delicate purpose, or to keep its colour well. Secundo.—The method generally given is this:—Lay your paper out flat, sheet upon sheet, brush over with Dammara resin dissolved in turpentine, and hang up to dry. This is very transparent and useful, but turns rusty.—H. H.

MANDRIL.—A Turner, whose mandril binds; can the set screw at the left end of his mandril work up tight, has he no hole for oil through the collar, or has it become blocked up? The absence of a shoulder will sometimes make no difference, at least in white metal bearings.—H. H.

The proposal made by An Enthusiast is an exceedingly good one. To soften ivory submit it to the action of aquafortis for twelve hours, it will then take impressions from a die capitally. To harden, immerse it in strong vinegar for five hours.—H. H.

AMATEUR.—The stereoscopic views; buy them very cheap; don't attempt it if only An Amateur.

J. M. K.—Alarum. I beg to refer this correspondent to No. 27, vol. 2, ENGLISH MECHANIC. I think it will do for him capitally. Will any correspondent instruct me how to transfer an engraving to China, glass, wood, or any material on which it would appear to advantage? Also, how to construct a small microscope cheaply? I expect some good information on these two subjects interesting to myself, and many other correspondents.—EDWARD MCGURK.

BATTERY.—I beg to thank Mr. Anion for his description of a secondary battery (in the ENGLISH MECHANIC, Christmas No.), for electrical apparatus; and, I, for one, should be very glad if he would please favour the readers of THE ENGLISH MECHANIC, with a description of the more powerful secondary battery, which has to be charged with one primary battery, and a primary coil of wire.—D. B.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

SUBSCRIBER FROM THE FIRST.—There is no truth in the report that the ENGLISH MECHANIC has been sold, or is about to change hands. It is true, however, that the proprietor quite recently refused the offer of a very large sum of money for the copyright of the work.

A SUBSCRIBER.—See last number.

C. R. WOOLPIT.—An American invention.

M. E. X.—You are mistaken. It is well known, and has been long used for the purposes of stone induration at the Westminster Palace and elsewhere. It can be obtained through an artist colourman.

SLIDE LATHE.—Please forward the drawing.

B. H.—At some future time we may return to the subject, but at present we are too crowded.

CALLUM PAIS.—Can have a drawing of a spinning-wheel by forwarding his address and a postage stamp.

C. A. BERRY.—See back numbers. The question has been often answered.

A LEAMINGTONIAN.—A good suggestion, and will not be lost sight of.

CHURN.—Write to the Secretary of the Cattle Show. You will receive an immediate answer.

W. J. E.—Try Panonian Buildings, Park-road, Clapham.

GREGORIOUS.—Received.

W. STOCKS.—We cannot spare room. See lists in Post-office London and County Directories.

YOUNG IDEA.—We shall be glad to hear from you.

S. W. SANGSTER.—Write to the Secretary.

ALF. S.—You may substitute a chimney for the blast; let it be not less than 50 feet high. With regard to the other matter, you know your own business best.

ERINO (Dublin).—Multiply area of piston in square inches by the pressure, and the product by speed of piston in feet per minute; divide this product by 33,000, the quotient is the horse-power. Thus, the diameter of the piston being 6 inches, the area is 28·2744—or, say, 28; then 28 × 50 = 1400 × 37·5 = 52,000 ÷ 33,000 = 1·57 as the horse power.

F. TRUEFIT.—There are, at least, 6,200 locomotive engines in Great Britain.

S. F. G.—Your invention is a good one—possesses the essential element of simplicity; patent it at once, by all means; it will surely succeed.

N. S. (Perth)—Its velocity would be 94 feet per second with a fraction.

JUPITER.—Take this:—B = breadth of teeth in inches, P = pitch in inches, V = velocity of pitch line in feet per second, H = actual horse-power which may be transmitted. Then $H = \frac{P^2 V B}{9}$.

F. GRIERSON.—Get Youatt's "Treatise on the Horse."

YOUNG ENGINEER.—You must be well posted in the higher branches of arithmetic; i.e., involution, evolution, decimals, logarithms, and proposition, the first three books of euclid trigonometry, and geometrical drawing. Of algebra you should acquire sufficient to solve quadratic equations with ease. Get Law's treatise on "Civil Engineering," published in Weale's Series.

S. F. H.—A letter lies at our office for you.

In No. 9, Vol. I., we published an illustration of the Harrison boiler. Since then we have had many enquiries about it. The following, which has been addressed to a contemporary, will be useful to our correspondents:—

Sir,—In the number of your excellent journal for Nov. 17th, a correspondent makes enquiry about the Harrison Boiler. For his information I would state that I am making about five tons of this boiler per day at my works here, with a constantly increasing demand. I have made and put in operation in this country nearly one hundred of these boilers, varying from 150 to 5-horse power, within the last eighteen months, some of them in our very best establishments, and all giving the greatest satisfaction. All that ever has been claimed for this new steam generator has, in my opinion, been more than realised by constant use for several years. JOSEPH HARRISON, Jun., Patentee.

Harrison Boiler Works, Gray's Ferry-road.
Philadelphia, U.S., Dec. 3rd, 1865.

CITY OF LONDON FREE PUBLIC LIBRARY.—The Corporation of the City of London a few days ago unanimously voted the use of the Guildhall, recently restored at great cost, for the purpose of an Industrial Exhibition to be inaugurated on the 1st March next. On the motion of Mr. Thomas Lampray, F.R.G.S., of Paternoster-row, Member of the General and Executive Committees, it has been determined to devote the surplus funds towards the establishment of a free public library, for the City of London. Several city firms have already expressed their intention of liberally contributing to the project, and it is believed the Corporation will also lend its aid.

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MEETINGS FOR THE WEEK.

TUES....Medical and Chirurgical, 8½.
Civil Engineers, 8. Inaugural Address of Mr. John Fowler, President.
Zoological, 8½.
Syro-Egyptian, 7½. Mr. J. Bonomi, "The Pharoahs of the Bible."
Photographic, 8.
Ethnological, 8.
WED ....Geological, 8.
Graphic, 8.
Microscopical, 8.
Literary Fund, 3.
R. Society of Literature, 4½.
THURS..Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
FRI.....Astronomical, 8.

THE MECHANICS' EMPLOYMENT LIST.

SITUATIONS VACANT.

QUARRY MANAGER for a quarry in North Wales.—Letters stating salary required and other particulars to be addressed to Mr. Thomas Harvey, 13 Old Jewry-chambers, London.

COLLIERY ENGINEWRIGHT or engineer—must be a good engine fitter. Application to A. B, care of Messrs. Hicks and Allen, Wakefield.

BOOK-EDGE MARBLER and GILDER.—Constant employment to a thorough good workman.—Apply to Mr. Tuckett, Bookbinder, British Museum.

PAPER CUTTER.—Accustomed to cutting first-class commercial and print work.—Apply at 29, Bucklersbury, E.C.

WHITESMITHS.—First-class hand.—Apply at J. Rowe's, Arthur-mews, Praed-street, Paddington.

IRONMONGERS' ASSISTANT.—An experienced counter hand.—Apply personally to J. V. and Son, 3 Gracechurch-street, E.C.

BRASS FINISHER and GASFITTER.—Apply at 15, West-street, Upper St. Martin's-lane, W.C.

CARPENTER.—Constant Employment.—Apply at 27A Charles-street, Berkeley-square, W.

IRONMONGERS' ASSISTANT.—Apply to Geo. Richardson, Ironmonger, Waltham Abbey, N.

DORKING and LEATHERHEAD RAILWAY.—From 400 to 500 navvies wanted. Good wages given. Cash every day.—Apply on the works, near Leatherhead Station. Six good carpenters wanted for railway works; and three good Bramley Fall stone masons wanted.

ENGRAVER.—Send specimens, &c., to H. Rott, Swansea.

TIMBER TRADE.—Wanted, a town traveller.—Address, stating previous employment and salary required, to A. Z., 125, Fenchurch-street, E.C.

WORKING-SHOP FOREMAN of thirty joiners.—Address, stating salary, and where last employed, to C. F., Post-office, Wolverhampton.

A First-Class General STONE-CARVER.—Apply by letter to John Schofield, carver, &c., Cemetery-road, Dewsbury.

An Active Young Man as SALESMAN and FOREMAN at a Timber Yard.—Apply to Mr. May, Acorn Wharf, Old Kent-road.

A Man who thoroughly understands the carrying out of Sewerage Works and private drainage.—Apply to Mr. William Hoing, Workington Colliery, Cumberland, stating salary, age, qualifications, and references.

Two Good MASONS.—Apply to W. H. Tarraut, Marble and Stone Works, Swindon.

In a Builder's Office, a thoroughly practical man, as BOOK-KEEPER.—Apply, 47, Old-street, St. Luke's.

In an Architect's Office, a YOUTH, who has a taste for drawing. He will be received as a pupil.—Apply by letter to G. R. Mr. Batsford's, 52, High Holborn.

A steady, sober Man, as WORKING FOREMAN to plumbers, glaziers, and painters, competent to assist in the management of a business.—Apply to Mrs. M. E. Rogers, East St. Helen's, Abingdon, Berks.

COMPETITIONS OPEN FOR WORKS. ENGINEERING, SEWERS &c.

The Guardians of the poor of the Driffield Union are prepared to receive plans for a workhouse for 180 inmates, to be properly classified in accordance with the regulations of the Poor Law Board, and to contain suitable infirmaries, infection wards, lying-in wards, vagrant wards, accommodation for the officers, board room office, and all the requirements of a modern workhouse. Instructions and conditions may be obtained on application to Henry Botterill, Clerk to the Guardians, Driffield.

The directors of the Hull Dock Company give notice that the time for sending in the plans for the intended new office to be erected for their establishment at the port of Hull has been extended from the 20th to the 31st instant.

Drainage Works and Water Supply for the Wiveliscombe Water Supply. Particulars of B. Boucher, Wiveliscombe, Somerset.

Erection of station and other works for the London, Brighton, and South Coast Railway, Leatherhead and Dorking line. Particulars at the office of Messrs. Hood and Jacomb, 6, Little George-street, Westminster.

For sale by tender, about 1,440 trees, consisting of oak, alder, larch, and other descriptions. Particulars of Mr. G. Hussey, The Green, High Wycombe, Bucks.

Construction of brick and pipe sewers and other works for the Town Council of the Borough of Brighton. Particulars at the office of the Borough Surveyor.

Erection of a wrought-iron railing and four pairs of gates and fittings for same within the present enclosure of Paddington-green. Particulars at the Surveyors' Office, Vestry-hall, Harrow-road.

Erection of a groupe of ten model cottage buildings at the foot of the east Boniface Downs, and near the railway station at Ventnor, Isle of Wight. Particulars of Habershore and Pite, 38, Bloomsbury-square, London, W.C.

The Almanac issued by the Royal Insurance Company for 1866 is even more than usually interesting, while its typographical excellence is fully maintained. In the course of the remarks made therein the compilers have not confined themselves merely to the affairs of their own office, but have also made some very able observations on the general principles of Insurance and the Rules which should be followed to ensure success to an Insurance Institution and security to its client. The public will readily appreciate the importance and value of any considerations advanced on the subject of Insurance by such acknowledged authorities as the Managers of the "Royal," whose transactions are of the most extensive and successful nature. Much of the Pamphlet is devoted to the Actuary's Report on his valuations of the Life Liabilities of the Company, and on his last investigation into the affairs of the Life Branch generally. The figures showing the present position of the "Royal" may be briefly quoted as follows:—Annual Fire Premiums, £406,000; Amount assured on New Life Policies in 1864, £1,014,897; producing in New Premiums, £33 708. Total Funds in hand increased to £1,160,619. The last Bonus declared was again at the enormous rate of £2 per cent. per annum on the sum assured.

PATENT LIST.

(From the Commissioners of Patents' Journal.)

LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 30TH DECEMBER, 1865.

321. Preventing injuries from concussion, C. R. Markham—7d. 8 l.
334. Obtaining variable motion in sewing and other machines, H. Masters—8d.
335. Construction of roadways, pavements, &c., C. Henderson—1s.
336. Preparing flax and other fibrous substances, H. B. Barlow—10d.
337. Ships and vessels, R. Brassens and F. A. Le Mat—4d.
338. Steam engines, C. Langley—8d.
339. Candlesticks, &c., A. I. L. Gordon—8d.
340. Preparing straw for manufacturing paper, &c., J. Cornes and W. Simpson—4d.
341. Life belts, C. Kilburn—4d.
342. Reflector for street and other lamps, R. De Bray—6d.
343. Hair brushing machinery, J. B. Watters—8d.
344. Producing gases from mineral oils, W. Gibbs—10d.
345. Steam generators, J. Lake—10d.
346. Shot and shells, R. Brandon—4d.
347. Healds for looms, A. A. Larmuth—1s, 10d.
348. Separating grain, W. R. Newton—8d.
349. Fastening for stay busks, leggings, &c., G. Twigg—1s. 2d.
350. Ventilating pressing irons, S. E. Rosser—4d.
351. Fastening stays, C. Field—4d.
352. Pen and pencil holder, W. E. Willey—4d.
353. Miner's safety lamp, R. C. Thorp and P. Young—4d.
354. Grease for lubricating, J. Desmoutils—4d.
355. Wearing apparel, J. Singer—4d.
356. Metal pipes, W. Anderson—4d.
358. Breech-loading fire-arms, E. Lindner—8d.
359. Discharging cargo from ships, G. Elliot and H. Coxon—4d.
360. Wire and other netting, R. A. Brooman—10d.
361. Skirt borderings or linings, W. Staatts—4d.
362. Using abestos as an insulating material, W. A. Marshall—4d.
363. Protecting wooden surfaces from fouling, J. C. C. Halkett—4d.
364. Safes and strong rooms, J. Chubb—8d.
365. Propelling boats, ships, &c., M. Bier—6d.
3283. Aerial navigation, W. Clark.
3287. Air, deodorizing impure, J. J. and E. Harrison.
3172. Animal and vegetable substances, preserving, A. V. Newton.
3173. Atmospheric railways and carriages, A. Doull.
3253. Bichlorids of carbon and chloride of sulphur, R. Ransford.
3186. Billiards, adapting ordinary tables for playing, H. S. Marshall.
3206. Blasting powder, A. Budenberg.
3227. Carriages, drag for, A. E. Dobbs.
3210. Carriage wheels, naves and axletree boxes of, L. L. Sovereign.
3012. Chimney cowl, H. E. Newton.
3283. Coal, retort for extracting products from, J. Gibbon.
3043. Coke ovens, utilizing the waste heat of, W. E. Gedge.
3180. Electro-telegraphic purposes, wire conductors for, W. Boggett.
3178. Fire-arms, breech-loading, T. Wilson.
3249. Fire-arms, breech-loading, J. Aston.
3128. Fire Escapes and builder's scaffolds, apparatus for, E. Vagg.
2900. Goods, &c., 'lifts' for raising, J. Norris.
3289. Gun barrels, &c., metal tubes for, T. Rickett.
2630. Indian rubber, A. A. Lerenard.
3239. Locomotive engines, J. A. Longridge.
3222. Motive power, turbines for obtaining, W. Brookes.
3245. Paper pulp, W. A. West.
3199. Photographic surfaces, preparing, V. M. Griswold.
3279. Pistons, J. H. Johnson.
3231. Pulleys, W. Winter.
3195. Pyrotechnic toy, T. King.
3168. Railroads, permanent way of, H. A. Bouneville.
3084. Railway bars, &c., T. W. Dodds.
3224. Railway bars, J. Sanderson.
79 8. Railway steam engines and carriages, J. A. Loubat.
3291. Railway trains, signalling on, M. Siegrist.
3158. Railway wheels, tyres for, R. E. Price.
3200. Rivets, finishing, H. K. York.
3218. Rock, boring, F. B. Dosing.
3165. Screwing and tapping machine, E. Watteeu.
3194. Shutters, folding, J. Goddard.
3227. Slate, &c., cutting or getting, W. F. Cooke and G. Hunter.
3235. Steam, boiler for generating, J. C. Wilson.
3162. Steam, cooking by, G. T. Bousfield.
3269. Steam, generating, R. A. Brooman.
3226. Steam power, cultivating land by, P. W. Bowen.
2993. Sulphur, A. C. St. P. de Sincay.
3214. Tubes, tool for cutting, A. V. Newton.
2912. Water closet, P. Ellis.
3116. Winding machinery, J. J. Ashworth.
3188. Wood, tools for cutting, W. W. Hulse.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

BANKRUPT LIST.

TOWN.

Samuel Smith, Fish-street-hill, City, builder.
Robert Wheniman, Hampton-wick, painter.
Thomas Brown and Edward Brown, Hardington-street, Portman-market, Marylebone, carpenters.
James Livesay, Corbett's-lane, Rotherhithe, carpenter.

COUNTRY.

Thomas Cartwright, Swatlincote Mills, Staffordshire, dealer in stone.
Simeon Lilley, Birmingham, fog signal manufacturer.
James Glover, Coventry, plumber.
William Allington, Worcester, carpenter.
Thomas Jarman, Rhayader, Radnorshire, auctioneer.
Oliver Leivers, Beverlee, Nottinghamshire, joiner.
Thomas Morris, Llanduduo, Carnarvonshire, joiner.
Edward Brookes, Llanduduo, Carnarvonshire, miner.
William Prest, York, painter.

Tenders Sent in Works.

For Bedford Hotel, South Hackney, Mr. Peter Duval architect:—Wood, £3 052; Read and Son, £2 941; Perry £2 857; Carter and Son, £2,831; Ennor, £2,803.

For alterations to a warehouse, in Noble-street, City.—Mr. Herbert Ford, architect:—Palmer and Son (accepted), £200.

BARNET.—For the erection of college at Barnet, Herts, Mr. Ladds, 5, Lincoln's-Inn-fields, architect:—Rhodes and Roberts, £8,534; Thomas and Jenkins, £7 467 17s.; Cole and Son, £6,934; Nutt, £6,550; Stacey and Garrett, £6 318; Cuslim £6,120; Sawyer, £5,922; Muskin, £5,433; Donnelly, £4,240.

Plaistow.—Mr. J. W Morris, actuated:—Heiser, £1,250; Rivett, £1 223; Sheffield, £1,179; Cordery, £1,074; Kilby, £990; Ennor, £979; Stevens (accepted), £ 95.

MECHANICS' LIBRARY.

Architecture, History of. Fergusson. 3 vols. Vol 1. 8vo, bds.
British Association Reports. Birmingham. 1865. Crown 8vo, 5s., cloth.
Calculus, Differential. Supplementary volume. Boole. Crown 8 vo, 8s. 6d.
Co-ordinates, Trilinear. Price. Crown 8vo, 8s., cloth.
Farm Cultivation, Science and Practice of. Buckman. 8vo, 7s. 6d., cloth.
Iron Shipbuilding, Treatise on. Fairbairn. 8vo, 18s., cloth.
Lighthouses. Ballantyne. 12mo, 5s., cloth.
Mathematical Writings. Gregory. Edited by Walton. Life of, by Ellis. 12s.

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1858 .... 196,148 | 1862 300,699
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	Net Sum Assured on New Policies after deducting Gurantees. £ s. d.	Net Premium: £ s. d.
1860	449,241 16 2	15,079 17 10
1861	521,101 17 0	16,627 18 0
1862	701,427 15 3	22,333 13 2
1863	752,546 18 10	24,039 12 8
1864	1,014,897 11 5	32,708 10 7

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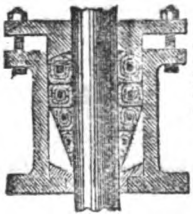

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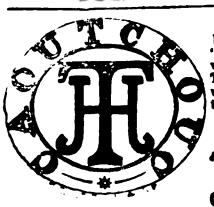

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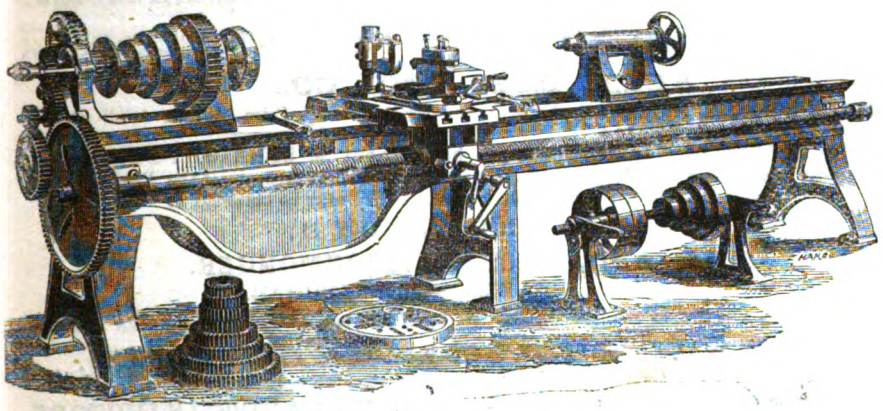

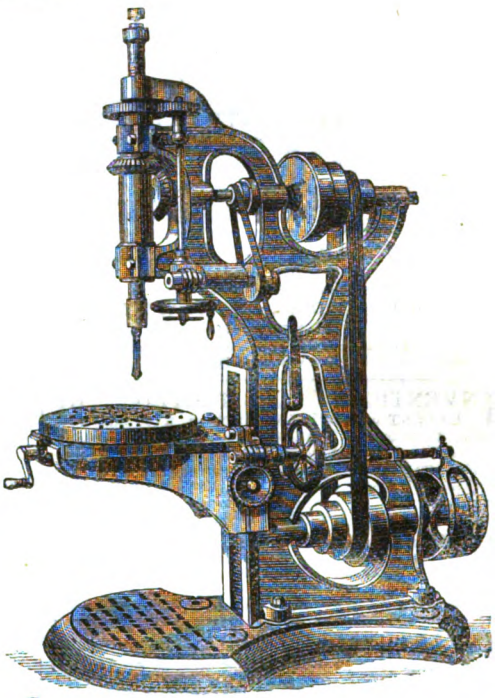

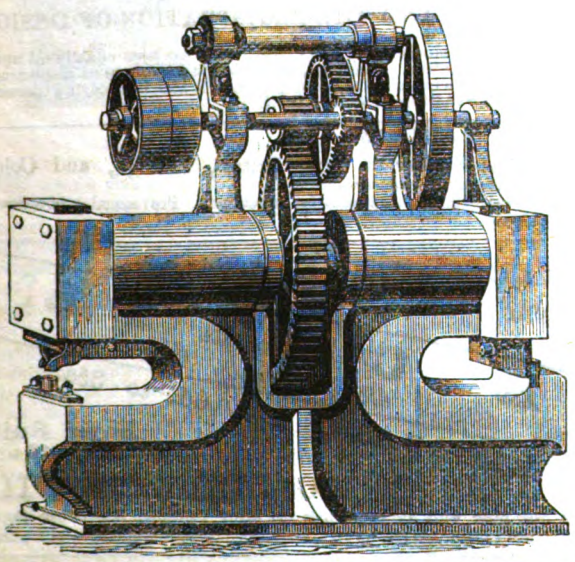

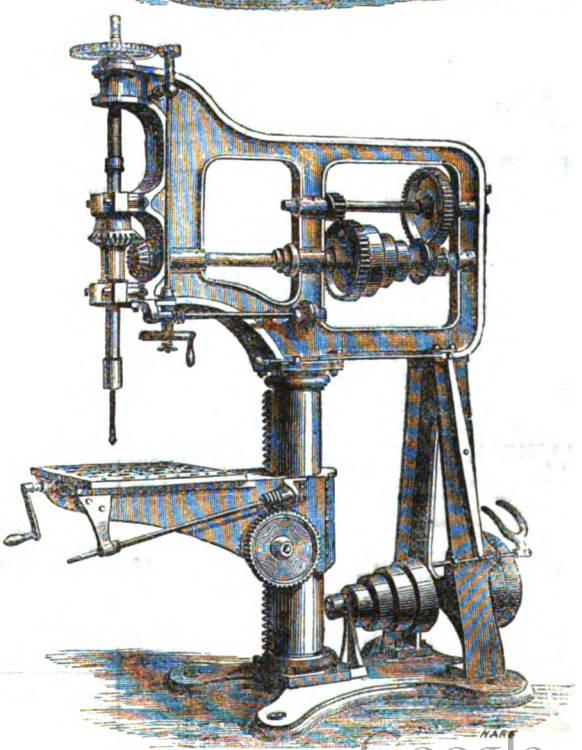

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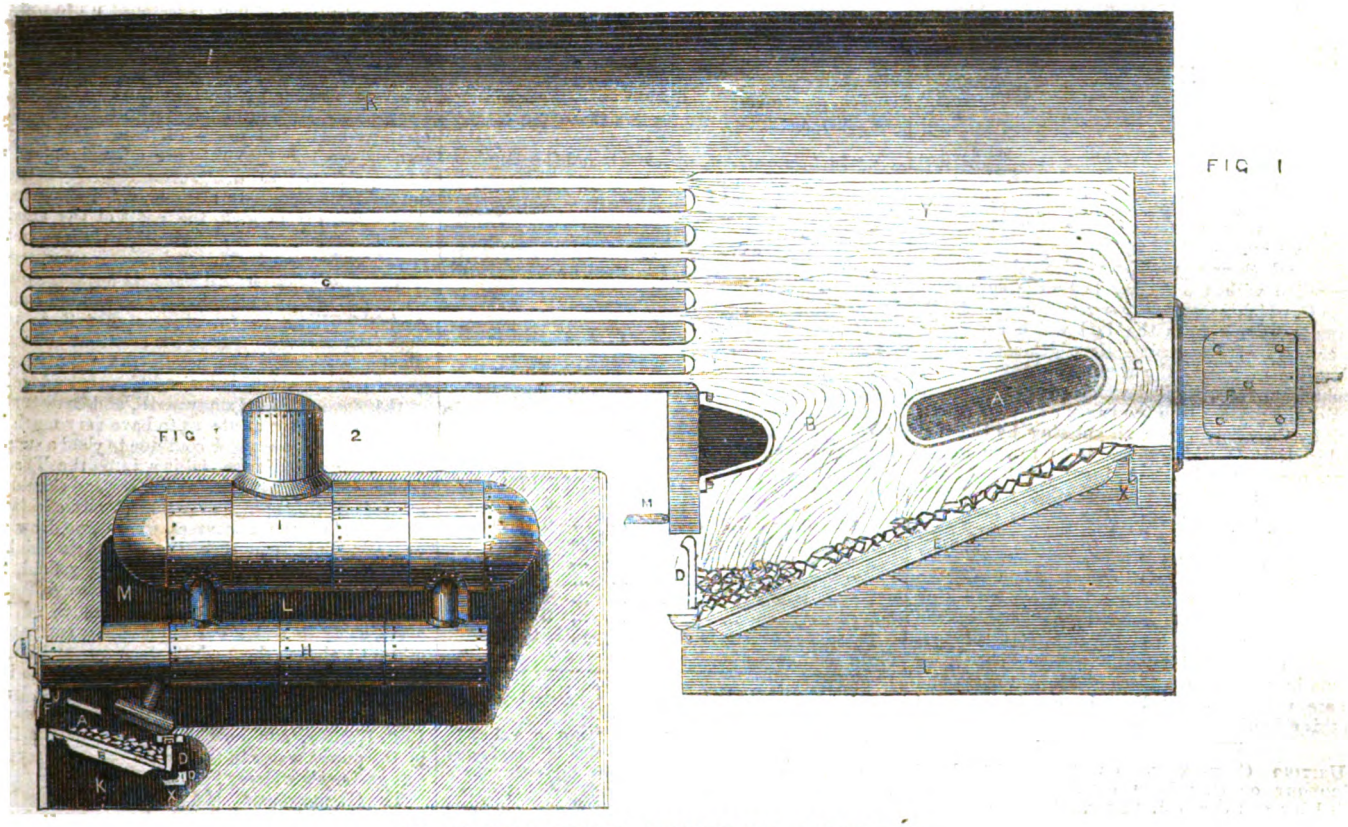
VOL. II.—No. 43.] FRIDAY, JANUARY 19, 1866. [PRICE TWOPENCE.



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THE result sought to be obtained by this invention of Mr. Blampoil, mechanical engineer, Paris, is the physical combination of the vertical and horizontal draughts, with the object of rendering the smoke incandescent with the flame.

In the illustrations Fig. 1 shows the application of the apparatus to a locomotive engine, and Fig. 2 its application to a stationary engine. In Fig 1 A indicates an upper boiler tube which breaks the direct horizontal draught; B a lower boiler tube serving to intercept and divert the vertical draught; C1 current of flame reserved to return to direct horizontal draught for the passage of the smoke to the upper part of the fire-place; C, tubular passages, and current of flame; D, bottom vertical moveable grating, serving to increase the combustion as air hole, and for throwing off scoria; E, fixed inclined grating serving to receive the fuel—it is inclined at an angle of 35 deg.; F, moveable door of fire-place; X, supports of the grating or fire bars; M, moveable damper to close the air inlet of the vertical grating; L, ash-pit and fire-guard; K, boiler and steam reservoir; Y, upper part of furnace.

The vertical draught in connection with the vertical grating, and the lower part of the inclined grating, by the current of flame C, which separates the boiler tubes B, A, draws the flame of the fuel which covers this space, and finds itself in combustion, and consequently purified; so that when the smoke of the fuel covering the upper part of the grating is slanted, and attracted by the vertical draught to the current of flame C, it is destroyed by the flame of the fuel which covers the lower part of the inclined grating, and of the vertical one. The direct horizontal draught being virtually suppressed by the tube A, the smoke which it draws through the space reserved at its upper part for the current of the smoke C1, gives for result a continuous eddy in the upper part Y of the furnace, and again "comes to destruction" in the flame of the vertical draught. The following advantages are claimed for the apparatus:—

1. The manual labour of withdrawing the coal cinders is rendered very easy by the grating D, which is worked from the platform.

2. Giving to the boiler, by the effect of the vertical draught, the generation of the production of the steam in the parts sensible to heat by means of direct flame at the tubing.

3. Easy inspection of and stopping of tubes, and lowering of steam pipes avoided in the replacing of the tubing, as the space between the boiler tubes B, A, leaves room for the passage of a workman in placing the tubes.

4. Avoiding the obstruction of the four lower rows of tubes by cinders.

A, in Fig. 2 indicates the upper break or reverberator intercepting the direct horizontal draught, and serving for the return of the smoke. In a fire-place of thirty-nine inches it should have a breadth of twelve inches, and be set in the lateral sides of the fire-place. It is of cast iron, rather less than an inch thick, and is inclined at an angle of 50 deg.; it may have a breadth of sixteen

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inches, with a thickness of eight inches, and its extremities will be let into the brickwork by the sides of the fire-place. Its elbow pipe is 6 inches in diameter, length at back 6½ inches, forward 4 inches, taken between the two bolted or riveted collars. C, current of flame; D, vertical grating serving for an inlet, its extreme height is 9¾ inches, division between the bars under ½-inch; E, grating inclined at an angle of 40 degs., space between bars under ½-inch; F, door of fire-place; J, space reserved for the return of the smoke, four inches from the side of the door of the upper part of the fire-place; P, recess fors upplying air; X, supports of gratings; R, ash-pit; M, brickwork; L, flues and current of flame; H, boiler tube; I, boiler. The dimensions vary with size of fire-place. The boiler tube may be replaced by a brick reverberator; but the inventor recommends the boiler tube, as economical, and for the generation of steam. M. Blampoil has made experiments with a boiler of 8-horse power, supplying an engine of 6-horse power, and gives the following as the results obtained:—

Without apparatus.—Average expense for ten hours' work, deduced from an experiment extending over thirty days—

Coal, taken from different localities ...	616 lbs.
Coal cinders	16 "
Slag or scoria	59 "

Pressure, 4 atmospheres, varying about ¼ an atmosphere. Fed constantly with condensed water.

With apparatus.—Average expense for ten hours' work, experiment extending over ten days—

Coal, from different localities	455½ lbs.
Coal cinders	None.
Slag or scoria	37½ lbs.

Pressure very progressive. Set at work in the ordinary way.

Physical Summary.—The vertical draught in connection with the grating D by the current of flame C, which separates the reverberators A, B, draws the flame from the fuel which covers the lower part of the grating E, which combustible being incandescent, the result is that when the smoke from the fresh fuel which covers the upper part of the grating E in the passage at C, is driven back by the effect of the air entering by the vertical grating D, which forces it to return to the upper part of the break A, it escapes by J, and comes back to be burnt at C—showing the almost entire use of the gases. The supply of superheated air in the recess P, gives for result a combustion which reduces the coal to the state of coke from the quantity of oxygen employed, the aim of which is to raise the caloric to a very high temperature, a result rendered evident by the waste scoria, which is reduced to a state of crystallisation. These statements and summaries, we should here notice, are those of M. Blampoil, and we are not aware that they have yet been acted on this side of La Manche.

UNITING CAST-STEEL OR CAST-IRON WITH WROUGHT OR CAST-IRON SURFACES.—James D. Whelpley and Jacob J. Storer, Boston, claim—1. Covering with some metal not easily oxidised, iron cores, either wrought or cast, perforated plates, wire or bars, when it is desirable to coat such cores with, or firmly attach them to, cast-iron or steel, previous to pouring upon them the molten metal, and for the purpose of permanently and solidly connecting wrought or cast-iron cores with cast-iron or cast-steel. —2. The use of glycerine solutions of cyanide or chloride of copper or silver rendered alkaline by alkaline cyanides and chlorides, and of chemically analogous solutions of tin and other metals for the purpose of depositing the thin, not easily oxidisable, metallic flim required in the process.—3. The alloy of franalinite metal (itself an alloy of zinc, manganese, and iron) with common cast-iron, in the proportions of from 10 to 20 per cent of the former to 80 or 90 per cent. of the latter, also similar alloys of iron, with zinc and molybdenum, tungsten, titanium, manganese, and other metals, when the proportions of manganese indicated in the above alloy, are replaced by equivalent proportions of metals of like properties in their alloys with iron.—4. They claim the construction of the wearing parts of pulverising mills and quartz crushers of cast metal attached to wrought-iron by the above process. 5. They claim the connecting of cast-steel, semi-steel, and Bessemer steel (so called) to wrought-iron surfaces by use of the process described.

THE ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART.

HEADS OF CONTENTS of No. 42 January 12:—Improvements in the Manufacture of Nails, Spikes, Rivets &c., with illustrations—Duration of the American Petroleum Wells—Accidents in Mines—Books on Turning—Ore Crushers—Kirkaldy's Iron and Steel Testing Works—Improvements in the Severing and Expansive Working of Steam Engines, illustrated—Reviews—British Gold—On Pure Water—The Electric Ray of the British Channel and other Electric Fish—On the Sublimed Oxigist of Vesuvius, and its Artificial Productions—Improved Chronometer and Balanced Throttle, with Illustrations—Shot Making in New York Combined Screw, Lathe and Drilling Machine, with illustrations—Photographing the Colours of Nature—A Bit of Chat—Cutting Screws by Change Wheels—An Old Philosopher—Rudiments of Photography—Electro-Metallurgy—New Centre for Lathe—Letters to the Editor—Notes and Queries—Replies to Queries—Tenders, Contracts, Patent Lists, &c.

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The English Mechanic,
AND
MIRROR OF SCIENCE AND ART.

FRIDAY, JANUARY 19TH, 1866.

THE WORKING MAN AND THE WATER SUPPLY.

WE are now publishing a paper on "Pure Water," by Mr. E. Lankester, extracted from a contemporary, which contains much "information for the million," especially valuable just now, when great complaints are being made through the public press that our hospitals for fever patients are not what they ought to be as to accommodation and extent. How much water is a necessity of life, and therefore a preventive of disease, is beginning to be better understood now-a-days, and few know what a filthy supply of water in the metropolis is better than that section of its inhabitants who have come up from some of our provincial towns, where attention has been paid to this great sanitary agent. *Mens sana in corpore sano*, is a maxim which cannot be too widely known, for a healthy mind never is the occupant of an unhealthy body, and much of the intellectual "twist," or as a sailor would term it "kink," in the body corporate, may with facility be traced to the lack of the great purifying agent, water. In this country few great cities or towns are worse supplied with water than is the greatest of them all, and this nearly every householder and working man in London is perfectly well aware of. We have a double house in our mind's eye, in which there reside nine families, and where there are two shops—one a low-class butcher's—to which there is but one cistern, whose contents are under thirty gallons, and which from its defective condition is full seldom oftener than once a week. True, there is an *underground* cistern, which is in the cellar where the butcher (!) keeps his bones and vile scrapings: that cistern has not been cleansed for thirty years! and yet six families draw their water supply from it, and the pump by which the water is drawn to the first floor is fastened up to the side of the only water closet on the premises! Our readers will not be surprised to hear that typhus held a levee there. This is but one instance out of many with which we are cognizant. Our readers are perfectly well acquainted with the vile system of water-butts, and many of them doubtless will own to the fact that they are often indebted for breakfast water to a "surreptitious" kettleful drawn from somebody else's butt "unbeknown." And yet this is London, the boast of the empire, where typhus fever is claiming his victims in the month of January! This filthy water accommodation is sufficient to poison the best water supply in the world, which London has not by any means got. And this leads us to observe that it is high time attention were paid to the fact that our water supply is growing less, whilst the population is growing larger. The main drainage, and other works, have dried up many wells, and so disturbed the water-bearing strata as to have very much interfered with those which continue to yield a supply. The natural drainage falling into the Thames is also growing smaller; and if sewage should be utilised by being spread over the uplands, and lands which drain into the sources whence we draw our water in bulk, why then the sooner we think of going farther a-field for the sparkling fluid, the better for all abstainers from ardent liquors.

Many schemes have been propounded of late years, some to assist our eight water companies, others to abolish them—buy them up, and absorb their plant (and that we are about to notice is of this last class); but whilst there has been a great deal of talking, Glasgow has gone right away to Loch Katrine, and now drinks and washes itself in the purest water in the world—clear as crystal, soft as Love's whisper!

The Glasgow man, Mr. Bateman, having been successful in the north, thinks he can be so in the south—and there is no doubt of it. To the monied and "pocketically" interested world, he has explained how he desires to supply London present and future with clear wholesome water—this in a private pamphlet "On the supply of water to London from the sources of the river Severn," but the pamphlet has percolated through the limits of exclusiveness, and is now finding its level throughout the press. The pamphlet is cleverly written, and the elaborate account of the scheme is cleverly laid down. The present water supply of London is one hundred millions of gallons per day—twenty years hence the quantity will have to be doubled, and that of an economic nature—soft, if at all possible—so as to keep down the soap and soda item in family bills. In Glasgow it is estimated that the softness of Loch Katrine water is saving its inhabitants at the rate of £36,000 a year upon a population of 400,000—this not including the saving in the various establishments where water is used in the operations. Taking his departure from this point Mr. Bateman is of opinion that by substituting water of one degree of hardness for that at present in use—

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which averages from twelve to sixteen degrees of hardness—the saving to London could not be less than nearly half a million sterling per annum! Mr. Bateman being of opinion, with others, that the supplies of large towns ought to be sought for in those mountain districts where the largest amount of rain falls, where there is little or no population, where manured lands scarcely exist, and where copious springs are constantly supplying the purest and softest waters, he casts about for a spot whence 200,000,000 gallons of water could be drawn daily, and which should be at such an elevation that the metropolitan district would be supplied by gravitation, without pumping; and away he goes boldly to the districts in the vicinity of Cader Idris and Plynlimmon in North Wales—the upper basin of the tributaries of the Severn; there he finds an average rainfall of 70 in., and an available product of 45 in. From the district in question Mr. Bateman proposes to conduct the water to near Marten Mere, to the north-east of the town of Montgomery. An aqueduct would then cross the Severn close to Bridgnorth—on by Stourbridge, Bromsgrove, Henley-in-Arden, Warwick, Buckingham, Aylesbury, Berkhamstead, Watford, to the highlands near Stanmore, where service reservoirs on an immense scale would be constructed, 250 feet above Trinity high-water mark. The aqueduct from Montgomery to the reservoirs would be 152 miles, and could convey 220,000,000 gallons daily. There are, it is stated, no engineering difficulties, and no reservoir embankment will be over 80 feet in height. The cost would be eight and a half millions sterling. The cost to London would be £71.000 per million for the first instalment of 120,000,000, and £49,200 when the full quantity was laid on. To buy up the present water companies would cost £427,512 per annum, but a very great deal of this would be saved in disposing of all the existing pumping and other establishments, and in the concentration of management.

The scheme is a grand one, and we need hardly say recommends itself to the attention of all thinking men amongst us. So long as we have the poor with us, we may expect to have fevers bred in our midst; how much the ravages of this fell enemy might be lessened by an abundant supply of wholesome soft water, need not here be enlarged upon. It is high time the matter received the consideration it deserves—which it will ere long demand, if we would not have it made a police offence to wash down our shop-fronts with clean water, as has been the case lately in the provinces. We recommend Mr. Bateman to persevere with his scheme, to knock perseveringly at the door of the board-room at Whitehall, and down in the City at Guildhall. It would be a grand thing for a department of the Board of Works to take in hand and carry through, as they will one day have to look after our street paving; and when the grand scheme—if found practicable and profitable—is completed, we will do more than give Mr. Bateman a statue up at Islington.

WHAT IS THE PHOTOGRAPHIC PROCESS OF DEVELOPMENT?

HOW very few of us ever bestow even a passing thought upon the marvellous natural phenomena by which we are surrounded. The divine beauty and power of creation are rendered by their very perfection too subtle for the grasp of even our strongest and boldest minds. The poet and the philosopher vainly endeavour to make us see these things—we only smile at the intensity and fervour of their feelings, and go our own dull, unimpassioned way. The things they speak of are vulgar, tame, and uninteresting in the everyday ordinary aspect in which alone we see them. For most of us have never dreamt how absolutely limitless is the variety of loveliness, how boundless the scope of power, belonging to the common things of nature. The poet finds beauties in them ever new and ever changeful; the philosopher is always discovering in them unsuspected powers and mighty agencies of which the world has for ages been in ignorance; but we, we, the majority of "reflective" and "observant" human beings, what do we know or care about such things?

Poor little Polly (the nursemaid) presses to her humbly-covered bosom the stained, misty, dingy, glass photograph of her soldier love; Maude (the Duchess) sighs over the *carte de visite* of her absent lord, and one thinks as much as does the other of the servitors which travelled at the rate of 192 000 miles a second, a distance of ninety-five millions of miles to provide them with these light-created, love-cherished images! Nor need photographers smile at these loving damsels, but rather ask themselves how many of their vast army of sun-worshippers know more of such willing, faithful servitors than that they are rays of light, and that they require a certain chemically prepared surface to act upon? How many photographers want to know more than is associated with thus much? being, indeed, rather proud of the fact of knowing no more, prone to pride themselves upon such ignorance as something pre-eminently "practical." But amidst all our apathy and neglect He whose Love and Power is never less so rules that all day long the glowing sun pours down its harmonious flood of commingled rays, which are absorbed, reflected, and reverberated in thousands of accordant colours, hues, and tones, from the various natural objects. That "when night comes upon the earth, the stars and planets from their far-off seats above the clouds send down songs, fainter, but not less sweet, like the voices of birds singing as they float and circle in the sky; and always, and in all places, and amid the nearer, the more distant stars, and throughout the vast abysses of the universe, there floats everywhere, floats eternally, that commingled symphony of luminous vibrations which constitutes the grand visible anthems of nature."

To turn, however, to our more immediate subject. When Daguerre and Niepce were reaping the first fruits of their labours as the discoverers of photography, and Europe rang with one loud cry of wonder and delight, what were the things talked and written about? Portraits by light, landscapes and buildings drawn by their own reflected sun-rays; these, and the scores of suggested practical art uses of the new discovery, filled every mind. No one had leisure or inclination to think much about the natural wonders it laid bare, the new powers of investigation it placed with filial gratitude at the feet of its parent, Science. But soon fresh wonders dawned upon them, won by virtue of the researches this new art-science originated in the hands of Arago, Herschel, and Becquerel, Moser, Gaudin, and others. One of the earliest statements then made was that of M. Becquerel, who said—"It is not at all demonstrated that the photogenic modifications of the impressionable substances result from the action of the solar light itself."* A discussion then arose as to whether the photogenic effect was due to visible or invisible rays, during which a great number of experiments were performed, and a large variety of results brought forward. Mr. Moser of Konigsberg's experiments led to the belief that modifications analogous to those which certain surfaces experience under the influence of light were formed in the dark, on the surfaces of polished bodies, by mere contact, or by their being sufficiently near to imprint their images respectively one on the other. The mercurial vapours which developed or rendered visible a positive image on the daguerreotype plate were not necessary for the manifestation of such images, which are now generally known as Moser's, for it was found that an iodized plate became impressed with the visible image of a body placed near it in the dark without any such aid. It was therefore stated that "all bodies radiate light even in complete darkness," and that the images formed by such weak radiations on near surfaces may be rendered visible "by the use of any vapour, such for example as the vapour of water, mercury, iodine, chlorine, bromine, or chloride of iodine, &c., &c." It was also concluded that "there exists latent light as well as latent heat."†

M. Fizeau, in a communication of the Paris Academy, controverted M. Moser's ideas, and attributed the formation of the said images to the presence of slight films of organic matter sufficiently volatile to be removed by the vapours. Mr. Knorr, in a paper communicated by M. Bréquet to the Academy of Sciences, agreed with neither Fizeau nor Moser, and argued in support of the idea that such images were due to heat. Other theories were at the same time advanced with the view of showing the supposed connection between Moser's images and those impressed by light on the daguerreotype.

The idea of tracing the latent image of the photograph thus originated and pursued, has never been abandoned, still exists, and is the source of constant experimentalizing, but yet we seem almost as far from any definite conclusion as ever. Whether light acts in its production physically or chemically is the photographic question of the day, to resolve which the efforts of many talented experimentalists have been vainly devoted. It is extraordinary that the plate which is so extremely sensitive to the action of light, and so rapidly affected when exposed to it, should, when brought from the camera in which it has been subjected to its agency for a comparatively long time, be only changed by the presence of some invisible or latent image so subtle and delicate in its nature, and yet so powerful and continuous as to defy a series of powerful chemical actions to destroy it, and which image can be rendered visible both by the continued action of light or by that of any of those substances technically known as "developers." And next comes other mysteries as unresolved. What is this developer? How does it act? In what way is its action allied to that by which the latent image is produced? There are plenty who will answer all these questions with great ease and readiness, but the truly investigative inquirer will shake his head at their replies, and admit that to none of them have we any proper definite scientific answer. The light which the plate has absorbed may act, after all, as Moser implied, and the photographic image may be more due to the action of latent light on the developer than to that of development in the way most commonly ascribed. The simple fact is that our practice is in advance of our theory, and those grand principles on which the art is founded have in strict truth yet to be discovered. The molecular theory now most in favour as opposed to the idea of the chemical theory teaches that the photographic image is composed of metallic silver deposited from the nitrate of the developer, in those parts whereon the action of light has affected molecular disturbance. But recent experiments have thrown strong doubts on this view of the case. When iodide of silver is exposed to light the change produced appears then, according to the molecular theory, to be purely physical.

Mr. Carey Lea points out in the *British Journal of Photography*, that analagous effects may be produced by mere mechanical disturbance, and gives by way of illustration the following experiment:—"Take a clean, new, uniform glass basin, fill it with liquid, and cause a precipitation in that liquid. The precipitation will fall uniformly everywhere. But if we take a glass rod, and draw it across parts of the basin, so as gently to scratch the surface, and so that not the faintest visible mark is caused" (a somewhat difficult task by the bye) "and then cause a precipitate to gradually form from the liquid, this precipitate will in many cases follow every mark made by the rod, and, so to speak, *develop* these invisible rod marks." This gentleman then goes on to speculate as to what is the exact nature of the change photographic development produces, but, as he confesses, in no very hopeful spirit.

In the first place, he says, it may be "*a change* of crystalline form. We know very well that variations of temperature can cause changes of crystalline form (*e.g.*, in carbonate of lime) and light and heat are but different forms of one energy, different intensities of one manifestation," that which we call light. "Or the change may consist in the passage of iodide of silver into a polymeric compound," for "organic chemistry is

* It is not light, but a component part of light, which we term actinism, from the Greek word *actin*, a ray, by which it is said the photogenic change is effected.

† Every body not only reflects but also absorbs light.

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full of instances in which bodies pass with the utmost facility into polymeric forms with marked change of properties," while "there are facts in inorganic chemistry not easily explained, except by a similar view."

Having now shown the present theoretical position of development, and the starting point from which it has been reached, we shall in our next paper speak practically of the same subject. To ignore theory, and, "mechanically vain," rely purely and entirely upon "purblind practice," is no true wisdom; and we would urge upon our photographic readers the importance and necessity of demonstrating principles as the surest basis, and the most hopeful assistance to all future progress. We shall at all times be glad to chronicle the results of their experience, or give publicity to their suggestions, to aid them with our advice, or otherwise serve the great cause of Photographic Art and Science.

It is true that in this short paper I have given no new hints, that I have done little beyond demonstrating the general state of ignorance we have arrived at. But a consciousness of ignorance is the first step to attaining knowledge, and it is well for us to say with the philosophers I have quoted, and in the words of Fichte, "I will *know*: and should this be impossible, this much at least will I know—that it is not possible." It is in this spirit that all our great discoveries have been worked out, dug forth tediously fact by fact in the face of seeming impossibilities, and built up into those grand structures of applied science to which —whatever our station, character, or calling—we all owe so very very much! Let those who will turn their eyes from the attained wonders of "divine philosophy," to count up and sneer at the grim array of failures its students have laboured long and patiently to demonstrate. We know that by these very failures our greatest victories have been obtained; that a falsehood proved is a truth established, and that every truth so established is a stepping stone towards some new discovery, by which perchance the whole world may be vastly benefited.

BRITISH GOLD.

By ROBERT HUNT, F.R.S.*

Such is a rapid outline of the history of the search for gold in the British Isles, and judging from the recorded results—these it must be admitted are few—it is not very encouraging. In nearly every case the ordinary process of washing has been alone adopted. It is true some mining works were unsuccessfully carried out in Wicklow, with the hope of discovering the quartz lodes, from which the gold was derived which had been found in the rivers. We have now to examine, with some degree of care, the progress of quartz mining which has been carried forward for some years near Dolgelly, in Merionethshire.

In 1843 Mr. Arthur Dean discovered some rich gold ores at the Cwmheisian mines, not far from Dolgelly. This gentleman's further researches are said "to have proved that a complete system of auriferous veins exist throughout the whole of the Snowdonian or lower Silurian formations of North Wales." Mr. Dean describes this most interesting district as consisting of an immense number of alternate parallel beds of igneous and sedimentary rocks, traversed by mineral veins and trap dykes. A valuable paper on this subject will be found in the "Transactions of the Geological Society of London," to which we must acknowledge our debt for much of the geological information contained in this article. The geological relations, according to this excellent authority, are as follows:—On the north and west of the lower part of the river Mawddach lie the lower part of the Lingula flags and the Cambrian rocks. The latter consist of the coarse, thick-bedded, greenish-grey grits of Barmouth and Harlech. Their upper boundary is marked by a sinuous line, which strikes in a north-easterly direction from Barmouth to Rhaiadr-Mawddach, and from thence trends northerly a little east of Transfynyd to the turnpike road, about a mile south of Festiniog. The line then strikes S.W. to Morfa Harlech on the coast of Cardigan Bay. These grits are overlaid by that part of the lower Silurian rocks, known as the Lingula flags, which here consist mostly of blue slaty beds, generally more or less arenaceous, and partly interstratified with courses of sandstone. A well-marked portion of the series, composed of rusty ferruginous slate, occupies part of the cliffs of Moel Cynwch, that overhang Dol-fawr on the Mawddach. Both Cambrian and Silurian rocks have been penetrated by numerous greenstone dykes, some of which are magnetic. The following exact description of the metalliferous district is preserved in Professor Ramsay's own words:—

"Several lodes occur in this country in the neighbourhood of Dol-y-frwynog and Cwmheisian. The gold at Cwmheisian was discovered in 1843 by Mr. Arthur Dean, who, in a paper published in the 'Report of the British Association for 1844,' also stated, 'that a complete system of auriferous veins exists throughout the whole of the Snowdonian or lower Silurian formations of North Wales.' Recent events would seem, in a slight degree, to verify this bold assertion; but from that date to this time no one has heretofore attempted to work any mines in North Wales for gold, except that at Cwmheisian; nor have I ever met with any miner who has seen any gold of the alleged auriferous veins, with many of which I am also well acquainted. Cwmheisian has been worked several times, but, I believe, never with a steady profit. The gold is found in a branching lode, containing quartz with some iron pyrites. Its principal branch runs north-easterly, and is mostly composed of exceedingly hard quartz, which crosses the river about half-a-mile above Rhaiadr Mawddach. Another quartz lode, bearing lead, occurs a little above the waterfall. A north-west lead lode lies a little west of Moel-Hafod-Owen; and two others (one of them bearing silver) cross the river in the same direction, about half-a-mile below the fall. They pass through arenaceous slates and greenstone. Two north and south copper lodes cross the little valley that lies between Moel-Hafod-Owen and the hills beyond Dol-y-frwynog. Two others occur on the steep slopes that overhang Afonwen on the west, about half-a-mile south of Dol-y-frwynog. These four are in the talcose rocks above described. Several large quartz lodes traverse this country on Moel-Hafod-Owen. They are in the ordinary Lingula flags. The largest is on the east flank of the hill. The rocks are there much disturbed and altered, and numerous little bosses of greenstone are abundant among its beds.

"When I inspected the geology of this country in the spring of 1853, the most remarkable and promising lode was the new gold lode of Dol-y-frwynog. The lode runs W.N.W. and E.S.E. in the low ground south of Moel-Hafod-Owen on the east watershed. It is principally composed of a white saccharoid quartz, irregularly traversed by numerous small loose joints. Chlorite, decomposing talcose matter, and pink carbonate of lime, are intermingled with it. In parts the quartz assumes a semi-granulated aspect, profusely intermingled with soft unctuous decomposing talc. It is largely charged with iron pyrites. As a rule, the substance of the lode is easily shivered into fragments, a great advantage both in the original working of the lode and in subsequent operations. It was first opened in search of copper, and a shaft was sunk to a depth of about twenty fathoms. During the process, however, it soon proved to contain more attractive metal. On examining a heap of quartz which lay at the mouth of the shaft, and turning over a few pieces, I readily saw, with the naked eye, gold in small flakes and grains, irregularly disseminated through the quartz. In a more select heap of quartz, on all the pieces it was distinctly visible to the unassisted eye; and one mass in particular, heavier than a strong man could lift, was literally spangled all across its surfaces with rich glittering gold. Gold has also been detected by Mr. Byers in the matrix of the copper-bearing lodes about a mile further south, and in the west of Dol-y-frwynog lode, by the spot marked 'Turf Copper Mine' on the map of the Geological Survey. All these occur in the same talcose rock.

"On the banks of the Afon-wen, about a mile above the bridge, are some ruins of buildings, and below them, close to the river, the remains of charcoal ashes and bits of bones, mostly covered with herbage. This place has a very singular, and in conjunction with its late discoveries, a very significant name, which has maintained from time immemorial, expressive of gold having been melted or worked there.

"This name, 'Merddyn Coch'r awr,' signifies 'the ruins of red gold.' The tradition is, that the Romans formerly worked gold there. It may be well to observe, to those unacquainted with Welsh names, that no ancient place has a name but what is characteristic of its locality, or of some event that has taken place on or near the spot."

Mr. Arthur Dean was evidently the first person who called attention to the system of quartz lodes more or less auriferous, which have rendered this district remarkable. It is said, however, that a little gold was detected in one of the copper ore lodes in the year 1836. Of late Mr. Dean has been appointed engineer to the Vigra and Clogua mines, and this position has enabled him to study with much care the peculiar conditions under which the gold occurs in these quartz veins. These are especially deserving of the closest study —they are the only gold bearing rocks of this country—and the workings which are now in progress present opportunities which should not be neglected. Within an ellipse about fifteen miles long by twelve miles wide, are enclosed all the mines opened in the Dolgelly district. Outside this, other fields are found, the most promising being the Bala district, in which is situated the Castele Carn Dochan gold mine, which is now yielding, monthly, small quantities of gold. Nearly all the gold mines are opened in the lower Silurian beds, but in the Cambrian sandstones some of the quartz veins produce gold.

(*To be continued.*)

* Extracted from the *Quarterly Journal of Science* for October. Churchill and Sons.

TO CLEAN TARNISHED SILVER.—Wash the silver over with a strong solution of cyanide of potassium. Simultaneously with the development of a very disagreeable smelling gas, the metal becomes bright, and must be immediately washed with water and dried.—*Erdmann's Journal.*

BELFAST ARCHITECTURAL AND ENGINEERING ASSOCIATION.—The annual general meeting of the members of this association was held on Friday, the 5th instant, in the Library of the Museum, College-square. Conway Scott, Esq., C.E., occupied the chair. The annual report being read by the secretary, Mr. James Simpson, it was found that the association was never in a more prosperous position than at present, and likely to continue so, seeing that the numbers are considerably augmented, the increase of members during the past year being much greater than that of any previous year. The treasurer, Mr. James Wilson, having read his report, it was seen that there was a balance of cash on hands, which was also very satisfactory. The following gentlemen were elected as officers for the ensuing year:—James Thomson, Esq., A.M., A.I.C.E., president; Robert Young, Esq., C.E., vice-president; Mr. Wm. Kelly, treasurer; and Mr. Clarke, secretary; William Workman, Esq., L. N. Macassey, Esq., C.E.; Conway Scott, Esq., C.E.; and James F. M'Kinnon, Esq., C.E. (ex-president), members of committee. It was moved by Mr. Macassey, in an eloquent address, that a committee be appointed to consider the advisability of forming a scientific library or reading room in connection with the association. Mr. Wilson ably seconded the motion, which was subsequently put to the meeting. After an animated discussion, the proposition was carried by a large majority. The next meeting of the association will be held on Friday, the 19th inst., when Professor Thomson will deliver his presidential address.

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ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

JAMES SIMMS.—Asks if our columns are open to free discussion upon mechanical subjects, and states that he much admires the journal. We are afraid that, however much Mr. Simms may admire the outside pages of the ENGLISH MECHANIC, he can scarcely have troubled himself about the general contents. We beg him, however, to understand that we consider free discussion the most prominent feature in our journal, and that we not only "admit" letters on all matters relating to mechanics, but cordially invite all our readers and subscribers to contribute their mite to our columns of Notes and Queries. If diagrams are necessary for explanation, and the subject is worth the expense, or is likely to be in the slightest way useful to even a small section of our thousands of readers, we are willing to engrave them.

LEICESTER AMATEUR.—Purchase "Plain Lectures on Astronomy," published by Simpkin and Marshall, Paternoster-row. Price one shilling. A very handy and reliable little book.

C. F. B.—Thanks for the trouble you have taken; you are decidedly the originator.

LOCOMOTIVE ON COMMON ROADS.—The drawings will shortly appear.

FRET SAW.—A blunder of the printers, but only went through a few copies.

CRANK.—A similar question was answered in the first volume.

THOMAS DUNBAR.—We will endeavour to insert, but cannot promise, as the engravings will be expensive.

S. JAMES.—The dust and mud machines at present working in the City are admirably constructed. Unless you consider your own a very great improvement upon them, we advise you not to trouble yourself about a patent.

DAVID KNIGHT.—We are well aware that some of our correspondents make some dreadful blunders, but while doing so, they seek information from those who are willing and able to correct them. It is to such as these that we have opened our columns, and the course has proved valuable to many.

A. E.—We believe that the work was never completed.

S. T.—With your qualifications about £18 a month.

SCIENCE.—Burnt sugar and pine apple flavouring.

CHARLES SWAIN.—You can get particulars from Munn and Co., American Patent Agency, New York, U. S.

J. BRYANT.—Received.

B. SIMPSON.—Explain yourself more clearly.

MECHANICUS JUVENIS.—Write to Spon, Bucklersbury, and you will be pretty certain to obtain it.

PROSPECTIVE.—Weale, publisher, High Holborn.

R. CARTER.—1. We cannot learn the address. 2. In the columns of the *Engineer*.

W. T. SNUFF.—See Vol. 1.

T. H.—Will see that some of his suggestions have already been carried out.

H. BOOTH.—At the Admiralty office, either London or Dublin.

ELECTRIC PLATE MACHINE.—See back numbers on glass drilling; several modes have been advised in the Notes and Queries.

J. O. S.—Thanks for your good wishes. The market prices will appear regularly; they were left out of our last through error. Our article on Kirkaldy's iron testing is *not* from the *Engineer*. It was contributed by Mr. Kirkaldy, who also kindly furnished us with the blocks. It is a most able and interesting article.

Co. (Durham).—The slide valve, the oscillating engine, the screw propeller, all are open to improvement. Your leisure hours will be well spent upon these.

J. H. HUXBY.—Not received, or would have been noticed. Perhaps delivered to the office of some other mechanical paper.

C. LUCK.—Scarcely worth engraving.

J. JONES.—You have given your opinion and paid the postage; a penny ill spent.

W. JONES.—Three or four articles have appeared on silvering glass. Why not search through back numbers.

P. N. H.—You had better consult a practical builder. The cost would be slight, but must entirely depend upon the situation. As to the moulds, you must explain yourself more clearly.

WALTER EDES.—Thanks for your communication. Should anything fresh turn up, forward an account to us, with drawing, and we shall be glad to publish it. Anything new will be acceptable.

F. J. D. R.—Many thanks. Can you forward us the drawings?

J. N.—Thanks; we shall be glad to hear from you again.

D. S. L.—The distortion of steel during the hardening is chiefly due to the mode of dipping; the form of each article will suggest the best mode of avoiding this. Oil is preferable in many cases.

L. K. W.—The method of amalgamating the corroded zinc plates of a galvanic battery, discovered by Mr. Gibsone, is effective and simple. The corroded plate, which, not being previously scoured, is immersed in a liquid which contains two ounces of commercial hydrochloric acid, and one drachm of a saturated solution of corrosive sublimate, in which half an ounce of metallic mercury has been placed. The latter being rubbed over the plate with a tooth brush will immediately firmly adhere, the oxide of zinc being removed by the mercurial salt, which dissolves it.

A. WORKER.—The French wire nails do not split wood in consequence of their being parallel throughout their length, and having conical and not tapering points; a rectangular nail of the same thickness throughout its length, and with a wedge-shaped point, will drive without splitting, and hold firmly. A common pin will answer well if its taper point is cut off, and a conical point is formed upon it.

G. JOYCE.—At 42 pounds pressure per square inch, the volume is represented by 647, the temperature 270·2° Fahr., the total heat 1196·3° fahr.

W. CLICKSCALES (Edinburgh).—To find the height to which the water will rise at a given discharge, divide the discharge in cubic feet per minute by 192·6 times the length of the weir in feet, square the quotient, and extract the cube root of the product.

$$h = \sqrt[3]{\left\{\frac{Q}{192\,6.l}\right\}^2}$$

Let the length = 5 feet, and discharge = 120·375 cubic feet.

$$h = \sqrt[3]{\left\{\frac{120\,375}{192\,6.l}\right\}^2} = \sqrt[3]{\frac{1}{64}} = \tfrac{1}{4} \text{ of a foot,}$$

M. INNES.—The super elevation of outer rail on curves in inches is found by multiplying the gauge in feet by the square of the velocity in miles per hour, and dividing the product by the radius of the curve in chains, and by 397·5. You can figure for yourself now.

T. PETRIE.—The side of any regular polygon multiplied by its perpendicular and by the number of its sides equals twice the area.

E. PRICE.—We cannot say for certain. But air, by its elastic quality at 3½ miles above the surface of the earth, is twice as rare as if at the surface; at 7 miles, 4 times; at 10½ miles, 8 times; at 14 miles, 16 times.

GEORGE BULL.—No—you are wrong; our man is right. For instance, a pinion of six teeth acting on a wheel of 57, will make it turn twice, while it turns 19 times itself, because $\frac{6 \times 19}{57} = 2$; or, a pinion of 9 teeth acting on wheel of 81 will make it turn 3 times while itself turns 27 times $\left(\frac{9 \times 27}{81} = 3\right)$; or a pinion of 12 teeth and a wheel of 96 gives $\frac{12 \times 32}{96} = 4$, $\left(\frac{15 \times 44}{110} = 6\right)$.

J. HARPER.—Only through the Secretary.

B. HAILES.—You might try Mr. Reed, the chief constructor of the navy—an estimable gentleman.

ARCH. JOHSON.—The following, we think, will suit you from your sketch, &c.: a = area of circle; c = circumference; d = diameter; D = dia. circumscribed circle; s = side of square = in area of circle; S = side of inscribed square. Then, $a = \cdot 7854\ d2$. $a = \frac{cd}{4}$. $c = 3\cdot 1416d$. $d = \cdot 31831c$. $d = 1\cdot 128379\sqrt{a}$. $d = \cdot 70710678S$. $d = 1\cdot 128379s$. $D = 1\cdot 4142148$. $s = \cdot 8862269d$. $S = \cdot 2250791c$. Send us the other sketch.

S. P.—We are not surprised. In measuring lead the dimensions should be carefully taken, the material being heavy and expensive, and small errors in the superficial dimensions are serious when reduced to weight.

F. GWILT.—In kyanising, a pound of corrosive sublimate to 10 gallons of water is used when a maximum strength is required, and 1 pound to 15 gallons of water when a minimum, according to the porosity of the timber. With the latter proportion, 1½ pounds suffices for a load of timber of 50 cubic feet.

NEIL S.—Twelve inches from centre to centre.

J. H. B.—It is a long and tedious process, that we have not space to describe. To be perfect would require an apprenticeship.

R. C. L.—MECHANIC received.

P. S.—See "Notes and Queries."

R. H. M.—Write to Spon Bucklersbury.

G. G.—At 40, Cranbourne street, Leicester-square. Price according to size.

W. LAWRENCE.—Keighley, Periosteum, J. M. Moss, P. R. Tyro, J. P. Q., Alfred, and many others in next number. We are terribly crowded this week, and must ask grace from those whose communications are not inserted or remain unanswered.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

COMPETITIONS OPEN.

The Town Council of Bristol have advertised for plans and approximate estimates for the adaptation of the present site for their proposed new Assize Court, and also for plans for the Queen's-square site. Architects are not offered a farthing of recompense.

Plans are wanted for the erection of two cottage houses in Gateshead. The cost, exclusive of site, not including architect's commission and all other expenses, is not to exceed £1,400. No premium is offered.

MIDLAND RAILWAY TERMINUS AND HOTEL.—In the month of July last the directors of the Midland Railway Company invited a limited number of architects to submit designs in competition for their proposed station buildings and hotel, at St. Pancras. After carefully considering the merits of the various designs forwarded, the directors have selected that of Mr. G. G. Scott for execution, and awarded the premiums to Messrs. G. Somers Clarke, E. M. Barry, and T. C. Sorby. The contemplated outlay is about £300,000.

MEETINGS FOR THE WEEK.

TUES....Civil Engineers, 8. Discussion upon Mr. Grant's Paper, "On the Strength of Cement;" Statistical, 8. Mr. T. A. Welton, "On French Population Statistics;" Pathological, 8; Anthropological, 8.

WED....Society of Arts, 8. Mr. Alexander Bain, on "Automatic Telegraphy;" Meteorological, 7; London Inst. 7.

THURS..Zoological, 4; Royal, 8½; Antiquaries, 8½; Linnæan, 8; Chemical, 8: 1. Dr. Gladstone, "Pyrophosphotriamic Acid." 2. Prof. Wanklyn, "Reactions of Sodium-ethyl." Numismatic, 7; Royal Society Club, 6.

FRI.....Royal Inst., 8. Prof. Tyndall, on "Radiation and Absorption, with reference to the Colour of Bodies and their State of Aggregation." R. United Service Inst., 3. Lecture by Mr. Oliver Byrne, "The New Science of Dual Arithmetic applied to Naval and Military Calculations."

SAT.....R. Botanic, 3½. Royal Inst., 3. Prof. Westmacott, on "The Way to Observe in Fine Arts."

PROPERTY RECORD.

—o—

AT THE GUILDHALL COFFEE-HOUSE.

BY MR. WHITTINGHAM.

Freehold residence, situate at Leytonstone, Essex—sold for £980.

Freehold building land, situate on the High-road from Stratford to Wanstead and Harvey-road—£65 to £280 per plot.

Freehold building land, fronting White Hart-lane and New-street, Barnes, Surrey—£20 to £42 per plot.

Freehold building land, situate in Crescent and Grange-roads, Leyton, Essex—£25 to £120 per plot.

BY MESSRS. DEBENHAM, TEWSON, AND FARMER.

Freehold residence, known as Elm Lodge, with grounds of about one acre, situate at Surbiton-hill—sold for £3 800.

Leasehold premises, being No. 7, Little Tower-street, let on lease at £120 per annum, term 49 years unexpired, at a low ground-rent—£2,830.

Freehold Swiss villa, known as Alpine-cottage, Coborn New-road, near Victoria-park—£670.

Freehold plot of building land, situate at Caterham, Surrey—£235.

AT GARRAWAY'S.

BY MR. EWINS.

Freehold building land, situate and adjoining 8, Artillery passage, Widegate-street, Bishopsgate-street—£300.

BY MESSRS. E AND H. LUMLEY.

Leasehold two residences, being Nos. 8 and 9, Belgrave-terrace, Elizabeth-bridge, Pimlico, producing £100 per annum, term 71 years from 1829, at £40 10s. 6d. per annum—£600.

BY MESSRS. SCORELL AND JENKINSON.

Leasehold two residences, being Nos. 8 and 9, Mildmay-row, Newington-green, producing £137 per annum, term 14½ years unexpired at £60 per annum—£550.

Leasehold cottage, being No. 4, Smith's-cottages, Upper Orchard-street, Lyham-road, Brixton-hill, let at £18 4s. per annum, term 26 years from 1835, at £2 per annum—£100.

BY MESSRS. VENTOM, CLARK, AND BULL.

Absolute reversion, on the death of a lady aged 56 years, to a freehold residence and 40 acres of land, situate at Englefield-green, Egham, Surrey; sold for £6,250, subject to a mortgage of £4,000.

Freehold shipbuilding yard and premises, situate in Thames-street, Greenwich, let on lease at £175 per annum; sold for £2,375.

BY MR. EDWARD HARRISON.

Copyhold messuage, outbuildings, premises, and 11a. 1r. 14p. of arable land, situate at West Ham, Essex; sold for £1,625.

TENDERS SENT IN FOR BUILDING WORKS.

Alterations and additions to house and warehouse, at Kettering, Mr. Johnson, architect:—Buswell, £877; Watkin £814; Briskett, £789; Henson, 1952; Wilson, £742.

Rebuilding No. 42, East-street, Brighton, Mr. H. Jarvis, architect:—Bywater, £4,640; Rider, £4,580; Thompson, £4,540; Fabian, £4 390; Cheesman, £4,375; Henshaw, £4,304; Bland, £4,118;.

For erecting a dwelling-house and stable in the Lordship-road, Stoke Newington. Mr. F. G. Widdows, architect:—Ennor (accepted) £2,734.

Erecting a tavern at South Hackney, Quantities supplied by Mr. F. G. Widdows:—Ennor (accepted) £2,803.

Rebuilding 12, 13, and 14, Newington Causeway, Mr Henry Jarvis, architect:—Turner & Sons, £4,313; Marsland, £4,208; Piper & Wheeler, £4,180; Taraant, £4,024; Patrick, £3 960; Rider, £3,930;, Henshaw, £3,850; Thompson, £3,780.

Alterations and repairs at No. 22, Parliament-street, Westminster. Messrs. Wimble & Taylor, architects:—Allen, £506; McLachlan, £498; Colls & Sons, £484; Moultrie, £476; Marsland & Son, £465; Adamson & Son, £463.

Erection of farm buildings, Foston, near York. Mr. John Gibson, Malton, architect. Dring (accepted) £230.

Erection of seven cottages at Low Hutton, near Malton. Mr. John Gibson, Malton, architect: Barry, £674; Tinsley, £668; Skelton, £625; Hird, £609 2s. 11d.; Wilson & Baron, £594; Kirby, £551; Cooper & Fisher, £540 15s.; Dodsworth, £525; Wade and Danby, £469; Humphreys £437 12s. 6d.

Erection of a farm-house and farm buildings at Lendale Farm, near Kirby Misperton, for Mr. J. Mitcheson. Mr. John Gibson, Malton, architect. Quantities supplied:—Wood (accepted) £955.

Additions to Colverdon Brewery, Tunbridge Wells. Mr Charles Sheppee, architect:—Jackson & Shaw, £4,690; Patmon & Fotheringham, £45,585; Macey, £4,548; Mansfield & Son, £4,450; Auscomb, £3,958.

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BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

SINKING A WELL for the Trustees of the parish of St. Mary, Islington. Particulars of Mr. William Hicks, Parochial Office, Liverpool-road, N.

ERECTION OF COASTGUARD STATION at St. Andrew's, County Fife. Particulars at the Coastguard Office, Admiralty.

MAINTENANCE OF ROADS for the trustees of the Exeter turnpike trust. Particulars of Mr. Buckingham, 12, South-may, Exeter.

ERECTION OF A GROUP of 10 model cottage buildings near the railway station at Ventnor, Isle of Wight.

CONSTRUCTION OF RESERVOIRS.—Erection of boiler and dwelling house and construction of tunnel for the Tunbridge Wells Commissioners of Waterworks. Particulars from the Clerk of the Commissioners, Townhall, Tunbridge.

ERECTION OF ENGINE SHOPS, fitting sheds, &c., for the Directors of the Midland Railway Company. Particulars of the Secretary of the Midland Railway Company, Derby.

ERECTION OF NEW CHURCH, PARSONAGE AND SCHOOLS at Bradley, near Bilston. Particulars of Martin Baldwin, Esq., Bilston.

ERECTION OF BACON CURING WORKS &c., Cirencester. Particulars of Messrs. Cole and Son, Cirencester, or of Mr. Clissold, Russell-street, Strand.

RESTORATION OF THE CLOISTERS, Worcester Cathedral. Particulars of A. E. Perkins 9, College-yard, Worcester.

ERECTION OF A NEW INDEPENDENT CHAPEL at Great Berkhampstead. Particulars of Mr. Neale, 7, Portland-square, Bristol.

ALTERATIONS OF WORKHOUSE WARDS for the Guardians of the Kingston Union. Particulars of R. F. Bartrop, Clerk to the Union.

THE MECHANICS' EMPLOYMENT LIST.

SITUATIONS VACANT.

WATCH, Clock, and Jewellery JOBBER.—An experienced hand. Also an improver.—Address Field and Son, Aylesbury.

DIE SINKERS.—Good hands, used to Monogram Arms, lettering, and official seal engraving.—Apply at 177, Upper Thames-street, E.C.

COACHMAKER.—A foreman for an old-established business.—Apply to J. W. Ash, coachbuilder, Penzance.

FRENCH POLISHER.—A sober, steady man, who understands his business.—Apply to 279, High-street, Chatham, stating age, wages required, and where last employed.

IRONMONGERS' ASSISTANT.—A man, in-doors; must be well acquainted with the general country trade.—Apply to S. Allen, ironmonger, &c., Hoddesdon.

LOCKSMITHS and BELLHANGERS.—A good workman for a constant job.—Apply at 1, Drury-court, Strand, W.C.

STONEWARE POTTER.—Several throwers, accustomed to make ale bottles.—Apply to Mr. Miller, Port Dundas Pottery, Glasgow.

BRICKMAKERS.—An experienced man, to make white bricks by machinery, at per 1,000. Address, Dorset City Newsroom, 13, Philpot lane, London, E.C., post paid.

BRICKMAKERS.—First-rate hands, thoroughly experienced in the making of dark red bricks of the first quality.—Apply to D., Post-office, Cobham, Surrey.

LAND AGENTS AND SURVEYORS' ASSISTANTS.—Wanted a general assistant to map and measure well.—Address D., care of Mr. Sparks, law stationer, Exeter.

IRONMONGERS' ASSISTANTS.—An experienced man.—Apply by letter, to Y. Z., Messrs. Deloitte and Co., 8, Lothbury, E.C.

ALUM WORKS.—Foreman wanted.—Address, stating full particulars, R. S., 151, Cheapside, E.C.

UPHOLSTERER.—A steady, respectable man.—Apply to T. C., 27, High-street, Hampstead, N.W.

AN ARCHITECT and Surveyor, in good practice in the City, has a vacancy for an articled pupil.—Address, Mr. Lake, 1, Adelaide-place, London-bridge, E.C.

GOOD IRON FITTER for ornamental ironwork. Address, K. L., office of "The Builder."

CLERK of WORKS, experienced in Road-making and Sewering.—Applications to Mr. Edward Clarey, town surveyor, 53, High-street, Burton-on-Trent.

BRICKMAKERS required, first-rate hands, liberal wages given and travelling expenses paid.—Apply to D. post-office, Cobham, Surrey.

IN an ARCHITECT'S Office, a sharp active youth, a neat draughtsman.—Apply to B. W. post-office, Derby.

A MAN accustomed to Furness's moulding, thicknessing and Tenoning machine.—Apply at 16, Great Dover-street, Borough.

SEVERAL Good Sash Makers.—Apply at 69, Theobald's-road, W.C.

BY a CITY ARCHITECT, a Competent Assistant.—Address to Architect, care of Messrs. Everett, news Agents, Royal Exchange, E.C.

FOR a Small Steel Works, a Working Manager, must thoroughly understand melting and converting steel in all its branches.—Address, stating salary, to B.D., post-office, Dudley.

FOR a Small Works, a Working Foreman, where marine and locomotive boilers are made. Must have good testimonials.—Address, F. N., post-office, Dudley.

COMPETENT PERSON to take the management of a band saw; also an engine fitter.—Apply to John Shuttleworth and Co., Shoreham, Canal Ship Yards.

GLEANINGS FROM SCIENTIFIC WORKS.

The ratio of the spaces occupied by a given quantity of air in its greatest state of rarefaction is to the same under the highest degree of condensation as 550 060 to 1

Professor Schmid, of the University of Jena has calculated the weight of the atmosphere, omitting its watery vapour and carburetted hydrogen, at 612,489,851,187,053 tons.

The mean specific gravity of the water of the South Pacific contained between the parallels of 10 deg. and 40 deg. is 1.0.648 and between 40 and 60 deg. is 1.0.613.

The relative conducting powers of forged iron, steel, and cast iron are 436 397 and 359, taking silver, which is the best conductor, at 1.000.

Physical theory shows that the removal of the atmospheric pressure would raise the melting point of ice by 0.4 0th of a degree centigrade.

For every pound of water vapourised by the sun's heat at the equator, a quantity of heat has been expended sufficient to raise 5lb. of cast iron to its melting point.

The most ancient clock with wheels and balances mentioned in history, was constructed in England by Richard Wallingford, Abbot of St. Alban's, who lived in 1326.

In the reign of Edward I. 1,600lb. weight of silver was obtained, in the course of three years, from a mine in Devonshire, which had been discovered in the beginning of this reign.

The first balloon ascent, in Scotland, was made by M. Vincent Lunardi, in November and December, 1785. He twice ascended from Heriot's Hospital-gardens in Edinburgh.

In no place on the earth's surface, nor at any season, will a thermometer raised two or three yards above the soil, and sheltered from all reverberation, attain to 114.8 deg. Fah.

During the last year milk was brought to London from the country at the rate of eight gallons for each inhabitant per annum, rather less than one-fifth part of a pint a day each person.

The cost of the silver plates of the batteries constructed for the old Atlantic telegraph reached £2,529. A set of graphite plates, equal in number and size, were substituted for £216, at the suggestion of Mr. Walker.

The body of an averaged-sized man presents a surface of about 2,160 square inches, or 15 square feet and consequently sustains at the sea level a total pressure of 34,400lb., or nearly fourteen tons and a half.

The total quantity of the atmosphere has been estimated at a little less than the millionth part of the whole mass of the earth, supposing the mean density of the latter to be five and a half times greater than that of water.

In casting a large fly-wheel at Fort Pitt Works, Pittsburgh, the molten iron was conducted from the furnace across one of the streets of the city, a distance of 165ft., to the mould. The diameter of the wheel is 25ft., and its weight 42 tons.

Atmospheric air, on being condensed thirty times, has its capacity for heat reduced to one-half, and if suddenly compressed to twenty times its ordinary density, will disengage heat enough to slow an elevation of temperature equal to 900 deg. Fah.

A person at the equator is carried round with a velocity of 1,000 miles per hour.

In 1604 nearly 3,000oz. of Welsh bullion were minted at one time in the Tower.

The roaring of the volcano of Coseguina was heard at San Salvador, a distance of 1,000 miles.

The first engine erected in London by Watt was for a Mr. Goodwynne, who used it for brewing purposes.

A cannon ball, moving at the rate of 500 miles an hour, would take 9,000 years to travel from Saturn to the sun.

M. Savart discovered that the human ear can appreciate a sound of only the 24,000th part of a second duration.

The ancient silver penny was marked in the form of a cross, and thus was easily broken into a halfpenny and farthing.

The cow eats 276 plants and rejects 218; the goat, 449 and 126; the sheep 587 and 341; the horse, 262 and 212; the hog, 72 and 71.

Logwood and indigo began to be employed as dyes in Europe about the middle of the sixteenth century, but not without considerable opposition from the cultivators of the native wood; the former was prohibited in England by Queen Elizabeth, under heavy penalties, and all found in the country were ordered to be destroyed. Their use was not permitted till the reign of Charles II.

A substance which may be termed protoxide of ammonia has been discovered by Dr. Losson, of Berlin. It is prepared by submitting nitrate of ethyle to the action of metallic zinc in the presence of an acid. This substance forms a series of magnificent salts, remarkable for the facility with which they crystallise.

According to the experiments of Dr. Wehrle, of Vienna, the oxygen consumed by a candle per minute amounts to 16.6 cubic inches and the carbonic acid formed is 4.2 cubic inches. When the quantity of oxygen is reduced from 21 per cent. to 18 or 16 an ordinary miner's lamp is extinguished; an Argand lamp will burn until the proportion is reduced to 14 per cent.

Vessels made of zinc should never be used for holding milk as when milk is allowed to repose in contact with this metal a lactate of zinc is formed, as well as a compound of caseïn and oxide of zinc, both of which are extremely injurious if taken into the system. A solution of sugar, which stood a few hours in a zinc vessel, was found to contain a considerable quantity of salts of that metal.

The earliest railway of which there is any account was one constructed near Newcastle-on-Tyne. In Roger North's life of Lord Keeper North, he says that at this place, in 1676, the coals were conveyed from the mines to the banks of the river "by laying rails of timber exactly straight and parallel, and bulky carts were made with four rollers fitting these rails, whereby the carriage was made so easy that one horse could draw four or five chaldrons of coal."

THE LONDON ASSOCIATION OF FOREMEN ENGINEERS.

THE following is the substance of the Annual Address of Mr. Joseph Newton, President of the above Society, at a meeting held on the 6th inst., at its Rooms in Doctors' Commons, City of London:—

GENTLEMEN,—It was my intention to have offered some comments upon the position of our institution during the past year, and to have spoken of its progress and its difficulties. On the eve, however, of the anniversary festival, when our excellent Secretary will deliver his usual elaborate and comprehensive budget of information, charged with statistics and replete with details, I think I may spare myself the trouble. I shall content myself on this point by saying that the society, I believe, has made considerable headway, in spite of some adverse tides and contrary winds, and that it is now sailing on over a smooth sea, and with favourable gales, towards the harbour of permanent prosperity. I believe that we do not stand worse in the estimation of the general body of engineering employers than we did twelve months ago, and am sure that among our own class, the association is esteemed more than it ever was before. It only remains for members generally to interest themselves more than they have hitherto done in the progress of the society, and it must take a yet higher and yet more firm standing among the scientific and benevolent institutions of the country. We must have more paper reading and more discussions, more energy and less apathy, and then success is sure to follow. "So mote it be," as the Masons say. In the course of conversations which have taken place in our committee room at intervals, and in which conversations it has been my own privilege to share, it has been suggested that it would be a graceful and proper tribute to the memory of deceased members, if at the close of each year, sketches, however brief and imperfect they may be, would be given of their lives and characters. Unfortunately, it is impossible to stay the hand of death; but it is scarcely a fitting thing that it should fall upon any of our fellow-members—those who have attended our meetings, shared in our deliberations, and partaken of our cares and anxieties, our joys and sorrows—without some note, or, at least the "passing tribute of a sigh." During the year which has just closed, three ordinary members of this institution have gone to their rest, Mr Halley, Mr. Hill, and Mr. Stanley. Of the first-named gentleman it has not been possible to gain many particulars, although some attempts have been made to obtain them. He was known amongst us as an unobtrusive and intelligent man, pursuing the even tenor of his way, inoffensively and honourably. For many years he was in the employment of the Imperial Gas Company, and I have it from his chief there, himself a man who has risen from the bench and the vice to the office and the pen, Mr. David Methven,—that our departed friend had many excellent qualities, and a fair share of practical skill. He was esteemed by his employers, and lamented by those who served under him. We also place a cypress wreath of regret on his grave. Of Mr. Hill, whose untimely death we all so much deplore a greater amount of information has been obtained. Mr Hill was born in Bristol, in 1823, and passed the last twenty years of his life in London. For two years he was in the service of the Messrs. Rennie; and one year he passed at Messrs. Burton's, in Holland-street, Blackfriars, another year was spent at Messrs. Pontifex's. With Messrs. Shean and Sons Mr. Hill was engaged for two years. At the Atlas Company's works he served as manager for five years. At Messrs. M'Glashan's he acted as foreman for the space of five years. With Messrs. Merryweather and Sons Mr. Hill passed the last two years of his very active life, and by all those gentlemen he was deservedly respected. The melancholy circumstances attending the death of our poor friend are fresh in the recollection of all, and need not be recapitulated. It is gratifying to know that, thanks to the energetic and judicious exertions of Mr. Usher, Mr Walker, and other members of this institution, and the generosity of those to whom an appeal has been made, some assistance has been rendered to Mrs. Hill and her young and numerous family. Would that those whom Providence has blessed with abundance would yet further spare of it for solace of the widow and the fatherless. Mr. Hill was an active member of the Managing Committee of this association up to the hour of his death, and always advanced his opinions on matters of business with clearness, modesty, and conscientiousness. The society has reason to regret his demise on this account, as well as for Mr. Hill's personal attri-

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butes, which were homely, genial, and kind. *Requiescat in pace.* John Stanley was born at Sandon, a village near Buntingfield, Hertfordshire, on the 28th of September, 1804. His father held some copyhold lands which had descended from Sir Thomas Stanley, of Cumberlow Hall, in the neighbourhood. Sir Thomas was a knight and a philosopher of some repute in the time of Charles II. He wrote a work entitled the "Lives of the Twelve Philosophers," and was the father of the poet Thomas Stanley. The patrimony (after many divisions and sub-divisions) which fell to the lot of the father of our late respected member was very minute, and in order to support his family he tilled with his own hands his own lands. These circumstances, so straitened and so limited, left but little margin for educational purposes, and the eldest son, John, the subject of this sketch, was under the necessity of leaving school at nine years of age, and making himself generally useful in the fields, or tending the small flock for which his father enjoyed "common right." This latter occupation, if so it might be called, gave young Stanley facilities for developing mechanical and other ideas which had already taken possession of his mind. He was at this time fond of making models in wood, and among other works he constructed one of a neighbouring sheep-farm. This was effected with great accuracy, considering his limited resources, and it excited considerable sensation among the neighbours who saw it they declaring that our friend ought to be sent to London to be a mechanic. London, however, at this time was out of the question; there were no parliamentary trains, and no friends to receive young Stanley if he came to town His father gave him some tools and all his time to himself, and he made a lathe, a four-wheeled chaise, a light cart, &c, &c. In his fifteenth year John Stanley was apprenticed to Mr. Colson, a carpenter, near London, Mr. Colson's sympathies lay more near to the public-house than his own workshop, and his apprentice might have found himself in awkward plight had he not had some resources of his own to fall back upon He studied Nicholson's work on Carpentry, &c.; and made himself acquainted with that author's remarkable lines for hand-rail work and curved constructions, which are exhaustive, and cannot be superseded. Stanley profited so much by the instructions of Nicholson and his own perseverance that at the age of twenty he became acknowledgedly a most efficient spiral hand-rail man. This kind of occupation he followed for about two years, and for which he received very high wages. We find him next commencing business as a builder on his own account, and henceforth and for many years his life was a struggle. He waged the unequal contest of talent *versus* capital, and he was too honest to avail himself of deception of any kind. Less scrupulous men—and there are such tradesmen at present—did not hesitate to take advantage of his truthfulness. Stanley obtained a large business, but the profits arising from it were by no means proportionate. At thirty-two he married, and in this situation the same remark may be applied—he was soon surrounded by a family, but the means of supporting them were not so palpable. Stanley turned his attention to other subjects—thus he became, besides being a good carpenter, joiner, and cabinet maker, a smith, plumber, zinc worker,—millwright, engineer, &c., &c. Now he had, literally, too many irons in the fire; in trying to accomplish too much he failed in almost every undertaking. His customers deserted him, and a loss of £400 by the failure of a firm for whom he had been erecting a sugar refinery completed his ruin. Stanley was far to conscientious a man to allow others to suffer from his misfortunes, and instead of passing through the Bankruptcy Court, he asked for time, worked hard, denied himself comforts,—at last paid all his creditors to the full. In 1845, Mr. James took out a patent for weighing machines. Stanley constructed models for him with great success, and henceforth became, exclusively, a machinist. About the year 1860 our deceased friend patented some improvements in weighing machinery; one of these being to surround all the fulcrums by oil in cups This, with other improvements made Stanley's balances so perfect, that when loaded with a ton weight one ounce would turn them freely. The Excise department has adopted the Stanley balance. Other patents and many schemes owe their existence to our lamented brother member; and for the ten years immediately preceding his death Mr. Stanley was manager to Mr. David Hart, of Whitechapel-road, who has himself spoken to the writer in the highest terms of his late servant. As to the moral character of Mr. Stanley, it may be said that it was examplary. The workpeople of Messrs. Hart's shewed their esteem by presenting Mr. Stanley, about twelve months before his death, with a massive silver inkstand. He expired somewhat suddenly on the 3rd of August, 1865, and was buried at Highate Cemetery some days after, in the presence of 400 friends and acquaintances A widow, four sons, and three daughters, lament his loss. These latter are fortunately all in a position which does not require the active benevolence so essential in respect to the family before mentioned. I now come to a point or two, gentlemen, which is more personal to myself, and I ask your indulgence for a few minutes more. The period arrived when, according to the rules of our association, those officers who have performed duty during the past year, retire from their posts, I am anxious before leaving this chair, and giving place to my successor, to address to you a few parting remarks; and in order the better to convey to you my exact sentiments I have committed them to paper. Those remarks shall be brief and I trust you will bear with me while I read them. It was in February, of the year 1859, when my fellow members first did me the honour of appointing me chairman of this society. From that moment to this, with a slight intermission (the result of my own act), I have continued to hold that position, and I may say have honestly endeavoured to perform the duties pertaining to it. It has been my good fortune to witness during that period a material increase in the numbers of associated foremen, and of their friends, to have had the zealous co-operation and active assistance of many of them, and, as I believe, the good-will of all has been generously awarded me on almost all occasions. For these advantages I beg now most cordially to thank you; and at the same time I desire to say that my own support, such as it may be, shall be given to my successor, be he whom he may, in upholding the interests of this institution. It is impossible for me to retire without further observing that I think the time has really come when a change should be made, at least in regard to the holder of the principal office, and I beg of you to permit me, without any hesitation on your parts, to retire into the ranks from which your suffrages raised me. I have served my apprenticeship in the old fashioned style, for seven years, and am legitimately old and naturally "out of my time." I pray you therefore to give up to me my indentures, the conditions, of which are accomplished, and, not wishing to leave my old employers altogether, allow me to serve them in a more humble capacity. It has appeared to me always that the proper course for the society was to elect a new chairman every year, and I have invariably invited such a mode of procedure, and left the way open for its accomplishment. It has been said repeatedly that a precedent existed for my constant re-election in the fact that our ever to be lamented friend Mr. Sheaves occupied the same office for a number of years. There is no real parallel in the case, however, for to Mr. Sheaves belonged the honour of conceiving it, of assisting at its birth, and tending with zealous care the infant association during its early and helpless childhood. Mr. Sheaves was in short one of the parents of this society, and the society would have been guilty of a breach of one of the commandments had it not kept him at its head so long as that gentleman did not object to remain there.

I can claim no such relationship, and comparatively with some members I would mention I am but "the stranger within your gates.' In the list which occurs on one of the first pages of the copies of our rules and laws, I observe the letter "F" attached to several of the names, and a reference below interprets its meaning. F. implies that the owner of the name to which it is appended is a founder of the London Association of Foremen Engineers. It has often appeared to me that from one of that small band of pioneers, should your chairman be annually selected—so long as an "F" remained, who had not held the office. Thus would honour be done, mutually, and thus would a stain be removed from the annals of the society—the stain I mean of filial ingratitude.

You will pardon my offering this suggestion, but the idea has often burdened my mind, and I feel happy in being relieved of its weight. There is no reason why my obstructive coach should longer stop the way, especially since the road is cleared, and I myself am anxious to "move on." Such a change as I propose would be attended with many beneficial consequences. Young and aspiring members would see that the heights of presidential office were not inaccessible, and they would have a motive for working with redoubled vigour in behalf of the society, for the purpose of obtaining the suffrages of their fellows, and arriving at the honourable post. Others would imitate their laudable exertions, and recruits would come in with a hope of some day of obtaining promotion. Thus the arrangement would act and re-act, and the greater prosperity and more extended usefulness of the institution must be the certain result.

Enough has however been said on these points, and perhaps too much. They are urged nevertheless with but one motive, and that the future welfare of the society, and you will accept the assurance that no other could have induced me to press them on your notice.

I have foreborne to touch upon the question of the Superannuation Fund, the solution of which cost many of us no small share of trouble, and no inconsiderable amount of time and anxiety during the past year. I mention it now only for the sake of advising that no acrimonious discussions should be allowed to crop up in regard to it on any future occasion. For myself, I have to say that all symtoms of ill-feeling towards anyone who took part—either within these walls or without them—in the consideration of the Fund arrangements, have disappeared from my mind, and as the year 1865 has passed away into the illimitable and irrecoverable past, so have they gone away from me for ever If at any time I may have been betrayed into the use of words which the circumstances of the case did not warrant, or into the comission of an act that was offensive, I apologise for having been weak enough to yield to the unhappy impulse. It is my desire when I leave this chair to be at peace with all my brother members, honorary and ordinary, and all I ask them to grant me is a certificate to the effect that if I have committed any errors during my long term of official life, they were errors of the mind and not of the heart, errors committed not willingly, but unwittingly, and without improper motive. I shall not detain you longer, gentlemen, with matters so entirely personal to myself, but expressing my warmest thanks to such members as have personally aided me in seasons of difficulty, and to the remainder for the generosity and the forbearance I have almost invariably experienced at their hands, I say, so far as my occupation of this chair is concerned, farewell, and may you and your families enjoy a happy New Year. Mr. Newton then retired from the meeting, but his absence was of short duration, for he was unanimously re-elected, and on again resuming his old post, was loudly applauded by the very large assemblage present.

It was announced that the Anniversary Dinner of the Association would take place at the Freemasons' Tavern, on the 17th of February next, and that John R Ravenhill, Esq, C.E, would preside on the occasion.

ELECTRO-METALLURGY.

CHAPTER II.

No doubt those who have performed the experiment proposed in our last found it very awkward to keep the plates apart. We gave no instructions on the matter, that the student might devise his own plan, by way of exercising his ingenuity and patience, for those who do not possess these qualities will not make good platers. We chose to recommend the experiment in the manner we did that it might be tried at little expense; then if the operater likes the amusement and will follow our instructions, better working apparatus will be pointed out.

In our last we said, "On removing the electrodes, you will find one black, the other covered with a bright deposit of copper. Examine the bright one, bend the plate and mark if the deposit chips off in several pieces, or if it adheres so firm that a knife will not force it apart. If it chips, note that the impression upon its under-side is an exact counterpart of the original plate, to the most minute scratch. From this learn that, had the plate been engraved, you would have had a copy of it in relief, but, owing to some parts adhering, it would be broken and spoiled."

Fit up the battery and precipitating trough as before, but polish the negative electrode (that joined to the zinc, or positive plate) on one side with black lead, and the other with wax; this time make the solution stronger, say 3 oz. of the sulphate of copper in the battery and trough. Allow this to stand about twelve hours, or forty-eight would be better, as the deposit would be thicker.

Remove the plate and insert a penknife between the plate and the deposit, and it will part readily. The deposit will be on the side of the

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black lead only, none on the wax, and it will be an exact counterpart of the original. A similar experiment may be performed by substituting a sheet of gutta-percha treated with black lead for the negative electrode; allow it to remain about the same time in action. The wire in this case may be warmed and forced through a corner or at the side of the sheet before applying the black lead. Both these experiments should be performed repeatedly, for it is not so easy to get an even deposit as it would appear, nor can you readily insert or attach the wire without damaging the surface.

I know beginners are very anxious to copy something elaborate—large medallions, flowers, fruits, fish, &c., &c. Instructions for this will be given in due course; better proceed steadily, small things first.

I do not recommend more than the above experiments with the apparatus mentioned at present; if the student feels an interest in the art he had better provide the most suitable apparatus. In principle they are precisely the same as mentioned, but modified in form for ease in working.

A very suitable battery trough may be constructed thus, a wooden box, 8in. deep, 10in. long, 4½in. wide, internal measurement 1in. thick, divided into two compartments by a partition 1in. to make two cells, each 8in. by 4½in. by 4½in., set on a base 1½in. wider and longer than the box to prevent it falling over. At the ends and on the centre partition fix terminals or binding screws. (A very suitable description can be obtained for 4s. per dozen.) Next line the box with pitch, into which a little tallow has been mixed.—This is best accomplished by melting the pitch and tallow in an iron ladle, and pouring it into one cell while hot; then slanting the box in such positions that all parts may be covered, before it is too cold; pour back into the ladle any surplus, and re-melt for the other cell. A little tallow only is required, its use is to prevent the pitch from cracking; if too much be used, it will not set hard enough.

CHAPTER III.

Thus far I have intended these chapters for the young student in art, and it would be inconsistent if I did not remember that at this season of the year the young are prone to make merry—yes, and the aged too. I hope all interested in this miscellany will spend not only a merry but a happy Christmas and New Year. To all interested in scientific pursuits I wish the same. In honour to the season I shall digress from the last chapter, and leave it in abeyance until, the holiday over, we can renew our studies with refreshed mind. Something to read but not to study will be my subject this time.

Who discovered electrotyping? Well, up to the past week I thought I could have answered Spencer, but within the week a Mr. Wright claims it for his brother, Mr. John Wright, surgeon, of Birmingham, as the correspondence may be found in the *Times*. I will quote the last letter only, as a clue to the others, and proceed with the history of the invention as generally admitted up to now:—

THE INVENTION OF ELECTRO-PLATING.

To the Editor of the Times.

"SIR,—Seeing in your paper of Saturday last a letter from a Mr. Spencer claiming to be the inventor of electro-plating, I shall feel obliged if you will favour me with space to inform him and the public that I claim for my brother, the late Mr. John Wright, surgeon, of Birmingham, the honour of being the inventor of that process.

"Mr. Wright made an arrangement with the Messrs. Elkington for the patent to be taken out by Mr. Henry Elkington, which he did in Dec., 1837, agreeing to pay Mr. Wright 1s. per ounce for every ounce of silver or gold deposited by his process. This my brother received till his death, in 1844.

"After this his widow made another agreement with Mr. Elkington to pay her a handsome annuity for her life. She is still living, and is receiving the benefit of her husband's valuable discovery.

"I never heard of Mr. Spencer or any one else disputing the patent with Mr. Elkington, or yet claiming any royalty.—I am, sir, yours very respectfully,

"W. WRIGHT.

"32, Bucklersbury, London, Dec. 12."

Professor Volta invented the Voltaic pile, in 1800, and all modifications of that pile or battery have been called Voltaic after his name up to this time.

This totally new instrument becoming known to studious men in England and abroad, peculiarities in it were discovered, that never entered the mind of the inventor; thus Mr. Cruikshanks, of Woolwich, obtained metallic silver, lead, and copper at the negative electrode, with a pile after the principle of Volta.*

In 1805, Brugnatelli, in a letter to Van Mins, mentions, among other scientific facts, that "he had gilt in a complete manner two large silver medals, by bringing them by means of a steel prize into communication with the negative pole of a Voltaic pile, and keeping them one after the other immersed in ammoniuret of gold, newly made and well saturated."†

"Philosophical Transactions" abounds in cases that, more or less, lead to the art of Electrotyping, plating, and gilding, but all considered the credit is universally given to Mr. Thomas Spencer, of first suggesting its application to the art manufacture.

Mr. Thomas Spencer, of Liverpool, states that in 1837, while experimenting with a modification of a Daniell's battery, he used a penny piece, instead of a plain piece of copper, as a pole. Copper was deposited from the solution upon it, and on removing the wire which attached the penny to the zinc plate, he also pulled off a portion of the deposited copper, which he found to be an exact counterpart or mould of a part of the head and letters of the coin. as, smooth and sharp as the original. But this did not suggest to him any useful application until, some time after, he dropped accidentally a little varnish upon a slip of copper, which he was about to use in the same way as he had used the penny piece. On finding that no deposit of copper took place on the parts where the varnish dropped, he then conceived the idea of applying this principle to the arts by coating a piece of copper with varnish or wax, and cutting a design through the wax or varnish, leaving the copper bare, and then depositing upon these paste, so that upon removing the varnish, the design would be left in relief."‡ Although I have only quoted the dates 1800, 1805, and 1837, I could readily trace the discovery in its progress, year by year, if space could be afforded me; but I am compelled to be brief.

1. In 1805, Grothus's wrote expressly on the decomposition of liquids by Voltaic electricity. He considers the pile as an electro-magnet, *i.e.*, as attractive and repelling powers. The poles, from whence resinous electricity issues, attracts hydrogen and repels oxygen, whilst that from which vitreous electricity proceeds attracts oxygen, and repels hydrogen, &c., &c.

2. Sir Humphrey Davy's celebrated Bakerian lecture, on some chemical agencies of electricity, was read in November, 1806; and is almost entirely occupied in the consideration of *electro-chemical decompositions*. In "Philosophical Transactions" for 1807, pp. 28 and 29, Sir Humphrey confirms his previous views, slightly altered in terms.

MOMUS.

* See Wilkinson's "Elements of Galvanism," vol. ii., 1804.

† Naper's "Electro Metallurgy," page iii., 1860. Griffin and Co., London and Glasgow.

‡ Napier's "Electro Metallurgy," 4th Edition. Griffin: London and Glasgow. 1860.

PHOTOGRAPHY.

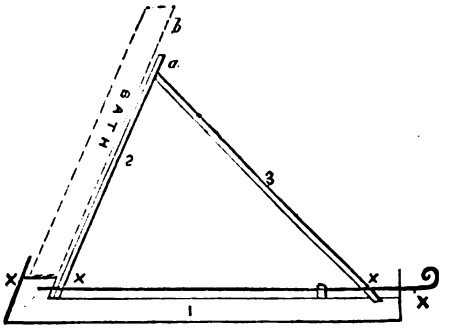
(*Continued from Page* 199.)

APPARATUS.

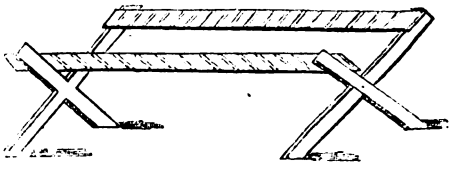
Do not go to any great expense at first, for, if you find you lack confidence in yourself, or that the pursuit does not agree with your health, you will, at least, have the satisfaction of knowing that some money has been saved. You cannot well do without the following, but, after a few months' fair trial, you will have gained sufficient as to what materials will be of really the most use. To start, then, a mahogany sl in body ¼ plate camera, *i.e.*, to take pictures 3¼ by 4¼ inches with rackwork combination lense to take either portraits or views, two dark slides will save a deal of running about. When you attempt a dry plate, see that the carriers are fitted with silver wire; wooden corners will frequently cause some mishap. A very good second-hand camera, with ash tripod stand and one dark slide, may be procured for £3 or less. If a black coating should be required in any part of the camera, lamp-black and thin glue will answer very well. Stoppered bottles are always more cleanly. I prefer to choose and purchase from the glass house at once at their cost price. The number and size must be judged of by the processes in hand, also a 1 ounce graduated measure, and two or three funnels holding six or eight ounces.

A half-pint glass of this shape will be handy. With a file and the ounce measure graduate the bottles; this will save the trouble when you want to replenish. An argentometer for denoting the number of grains to the fluid ounce of silver solutions is a *sine qua non*, the cost is about 3s. 6d. A small aquarium, or something to contain waste silver washings, &c., and a few strips of glass will almost complete this portion of your stock. In the earthenware line, a bath dipper for ¼ plate size, four glazed dishes with a corner lip—see that the bottoms are flat. When you arrive at printing, add to your stock three or four frames, cost about 1s. 3d. each, and two dozen Amer can pegs. Use quarter plate glass only—flated crown, if good, will answer—polished plate is too expensive for common use. Better to pay a trifle, more and have the glass selected free from bubbles, scratches, &c. If you can afford it, a glazier's diamond is always useful—cost 15s., and upwards. Other items you will require to start with are a box of weights and scales, with glass pans, a flat soft hair brush 1½ inches wide, yard and half of black cloth, a couple of soft leathers, two dusters and a file. If you possess a few carpenter's tools and a little tact, you can make a few requisites for yourself.

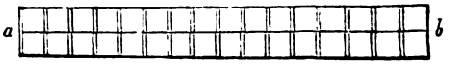
Your bath stand to take apart in three pieces, which will be convenient when you go for a day's outing, an old cigar box, if sound, will provide the wood.



x, pieces of thin brass with small screws, *a* fits into *b*, with a catch or easy mortice.



2nd. A rack for glasses, to dip or other purposes.



3rd. A long box for completed plates of ½ inch deal, about 5½ wide, by 3½ deep inside, provided with a lid. Then grove with a saw a strip of smooth deal 3 in hes wide, or more, the length of the box; divide from *a* to *b*, and fix inside to correspond.

PLODDER.

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ON PURE WATER.*

By EDWIN LANKESTER, M.D., F.R.S.

Continued from page 192.

Such waters have been the foundation of the reputation and fortunes of such places as Harrowgate, Cheltenham, Leamington, in this country, and Ems, Kissengen, Wiesbaden, Carlsbad, and others on the Continent. Many of the constituents which are in excess in these waters are the same as those contained naturally in the sea. Some of them, however, contain ingredients not found in the sea water in its normal condition at all, as the salts of iron and sulphuretted hydrogen.

Besides the substances enumerated, which are inorganic, sea and mineral waters contain naturally a certain quantity of organic matters, arising from the decomposition of the animals and plants which live in them.

The sources of water for the ordinary drinking purposes of man, are rain, springs, or rivers. Water obtained from these sources holds in solution certain substances, but not in so large quantities as the sea or mineral waters. Of the water ordinarily drunk, rain water is the purest. On account of its dissolving soap with facility, it is called soft water. When waters contain lime, they form an insoluble substance with soap, and are on that account called hard. As we use the word, a soft water is not necessarily a water containing a small amount of saline matters, but one that contains little or no lime. Rain water, as it falls from the clouds, contains no saline matters, unless we apply this term to the almost infinitesimal quantity of carbonic acid and ammonia which it is known to contain. When collected in the country in the open air, it it almost absolutely pure; but as it is usually collected for human use, it is liable to various impurities. Thus, in London and in large towns, it is collected from the tops of houses, and by the time it enters the cistern or water-butt, it contains a variety of impurities. It acquires carbonaceous matter from the smoke in the air, and small quantities of carburetted and sulphuretted hydrogen, so that its flavour is very disagreeable from that cause. From the roofs of houses it also collects another quantity of impurities, and especially the dung of birds, as of pigeons, jackdaws, and sparrows, which invariably frequent the roofs of the houses in our great towns. So that rainwater, although freest from saline matters of any water, is seldom collected in such a condition as to be fitted for dietetical or cooking purposes.

The other two sources from which our great towns are supplied are springs and rivers. London with its vast population is principally supplied from the river Thames, whilst Manchester, Liverpool, and Glasgow are supplied with spring water. No general comparison can be made between the purity of spring water and river water, as some springs come up highly charged with objectionable constituents, whilst some river waters present a purity unrivalled by any spring water.

The great object of every civilised community should be to secure pure water, whether it be derived from springs or rivers. Water is so essential to life, and its deficiency or impurity may be so destructive of health, that the supply of water ought never to be dependent on individuals. Like the air which we breathe it is amongst the first gifts of God to man, and no man has a moral right to stand between his fellow creature and this essential of his existence, and all arrangements which exclude the poorest from a healthful supply of this agent should at once be modified. Not only, however, is there a scanty supply of this necessity in many of our large towns, but great ignorance prevails of what are the conditions which render it impure.

Water itself, the chemical compound of hydrogen and oxygen, of which we have spoken, is always pure; but it has great chemical powers, and unites vigorously with other agents, dissolving them and holding them in solution. It is these substances which act injuriously on the human system, and which, not being required there, produce diseased actions in the body in order to get rid of them.

Spring and rain water do not materially differ from each other in composition. It may, perhaps, be generally stated that spring water presents a tendency to impurity from excess of inorganic constituents, whilst river water presents the same tendency from the presence of organic constituents. It should, however, be recollected that under the term spring water two very different sources of supply are indicated. In one case it is applied to springs which burst from rocks, and are discharged into rills on the surface of the earth, or to water obtained from deep borings in water-holding rocks; whilst in another case it is applied to water from wells sunk a few feet into the soil, and from which water is drawn by means of pumps. Such wells are frequently sunk in the midst of towns, and are the depositories of all kinds of organic filth from the percolation of drains and surface water of the district.

In referring to the constituents, then, of spring and river waters, which are likely to render them impure, I shall speak of them together. These substances may be divided into inorganic and organic. The inorganic are saline matters which are dissolved by the water in passing through or over the rocks of the earth, whilst the organic substances are the result of plants and animals which have lived in the water, or have been introduced by the contact of the water with dead organic matter.

The following table will give some idea of the composition of rain, spring, and well water in this country:—

NAMES OF SUBSTANCES.	GRAINS IN A GALLON. 1 River Thames.	2 River Severn.	3 Spring at Cheltenham.	4 Well at Clapton.	5 Well at Cheltenham.
Carbonate of Lime	12·75	3·36	8·46	15·09	35·2
Carbonate of Magnesia	1·02			13 97	
Sulphate of Iron	0·45	3·68	3·01	15·82	25·9
Sulphate of Potash	0·66	1·00	0·50	6·74	4·0
Sulphate of Soda	2·00	0·45	0·50	10·77	2 0
Chloride of Soda	1·10	1·84	0·41	11·46	25·6
Chloride of Calcium	1·75				
Silica.....	0·27	0·88	0·80	0·24	0·1
Total grains in a gallon	20·00	11·21	13·68	73·89	92·8

The columns 1 and 2 give the principal inorganic constituents of two of our great rivers; 3, is a fair specimen of spring water, from which the town of Cheltenham is now supplied; 4 and 5 are examples of surface wells. Much purer and much more injurious waters than these are now supplied to many of our towns. The supply from the Dee in Aberdeen contains but five grains of saline matter in the gallon, whilst the spring water from Loch Katrine supplied to Glasgow contains but three grains of impurity in a gallon; on the other hand, there are pumps in the streets of London supplying water with 200 grains of impurity in the gallon.

It may be asked here what may be regarded as the maximum of saline matter that may be taken without injury? This, however, is a difficult question to answer. At a sanitary congress held at Brussels in the year 1851 it was agreed that a good and safe drinking water should not have more than 35 grains of dissolved constituents in the gallon. This must, however, in a great measure depend on the nature of the salts, as we know that chloride of sodium and carbonate of lime are comparatively uninjurious, whilst the salts of magnesia in small quantities do harm. Various experiments of the quantities of the more common constituents of water, which may be safely taken have been given. The following may be regarded as an approximation to safe quantities. It may be said that a gallon of water should not contain of

Carbonate of Lime more than	...	20 grains.
Sulphate of Lime ,,	... ...	3 ,,
Salts of Magnesia ,,	... ...	3 ,,
Chloride of Sodium ,,	... ...	20 ,,
Carbonate of Soda ,,	... ...	20 ,,
Sulphate of Soda ,,	... ...	5 ,,

These are the ordinary constituents of water, but water from special circumstances may be rendered impure by very small quantities of other constituents. A water with very small quantities of iodide or bromide of sodium, the salts of iron, lead, copper, arsenic, or antimony, might soon become very injurious to health. The presence of large quantities of gases has also been objected to. Ordinary drinking water contains in the gallon about six cubic inches of nitrogen, 2½ of oxygen, and 5 to 7 of carbonic acid. These may be absent or in much larger extent without being injurious. There is one thing that should be recollected with regard to these gases, and that is, that they render the water sparkling to the eye and fresh to the taste, and that they are entirely got rid f by boiling.

It is almost impossible for persons who have not had a chemical education, to analyse water with that degree of accuracy that would enable them to judge of any particular ingredient there is in water. Nevertheless, I think it quite possible for intelligent people so to test water as to come to a tolerably correct conclusion with regard to its purity. Most persons use their senses before drinking water. Thus its colour and transparency may be at once detected by the eye. So accustomed are we to the true colour of water, that we at once detect any departure from its natural appearance. Blue water, green water, yellow water, are immediately detected and regarded as unnatural. The transparency of water is also recognised as a natural and necessary property. Indeed, water should be at once rejected, unless its turbidity is known to depend upon some uninjurious agent. The taste of water is still more generally known. Any departure from the insipidity of water is usually detected. Such departure should be noted, and any strange tasting water should be rejected. The sense of taste is essentially connected with that of smell, and sometimes the exercise of taste and smell may tend to the detection of impurities in water. Even the sense of touch may be employed in the investigation of water, as the action of hard water, or water containing much lime, is very appreciable to the touch in the process of washing the hands by the aid of soap.

Organic impurities are of more importance than inorganic, as they seem to be sources of much more fatal and dreadful forms of disease. It seems to be difficult to convince many intelligent people of the danger of drinking water containing organic impurities. They refer to the practice of taking organic matter in water in the form of soup and broth, and think this is sufficient to refute the evidence that the organic matters in water can do any harm. I think the evidence that organic matter in water, under certain circumstances, is injurious and destructive of health is abundant, conclusive, and satisfactory. I gave an instance at the beginning of this paper; I now give another. In 1849 cholera prevailed in the districts, supplied by two of the water companies of London—the Southwark and Lambeth Water Companies. In that year both companies obtained their supply of water from the Thames below Teddington Lock, and from parts of the river subject to great impurities. In 1853 the Lambeth Company had removed its source of supply from the river to a point above Teddington Lock. In that year cholera prevailed again in the district supplied by both companies. It was found that, during four weeks of 1853, there were 334 deaths; of these 286 deaths occurred in 40,046 houses supplied with water from the Southwark Company, which still obtained its supply from the impure source below Teddington Lock, whilst in 26,107 houses supplied by the Lambeth Company, there were only 14 deaths. This case was thoroughly investigated at the time by the late Dr. Snow, and the correctness of his conclusions was confirmed by the Registrar-General. In this instance there can be no doubt either that the injurious water did directly communicate the germs of the disease, or that it predisposed the inhabitants of the district who partook of it to the attacks of the poison of cholera.

(To be Continued.)

* From the *Popular Science Review*.—Robert Hardwicke, Piccadilly.

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MACHINE FOR CLEANING BRASS TURNINGS.

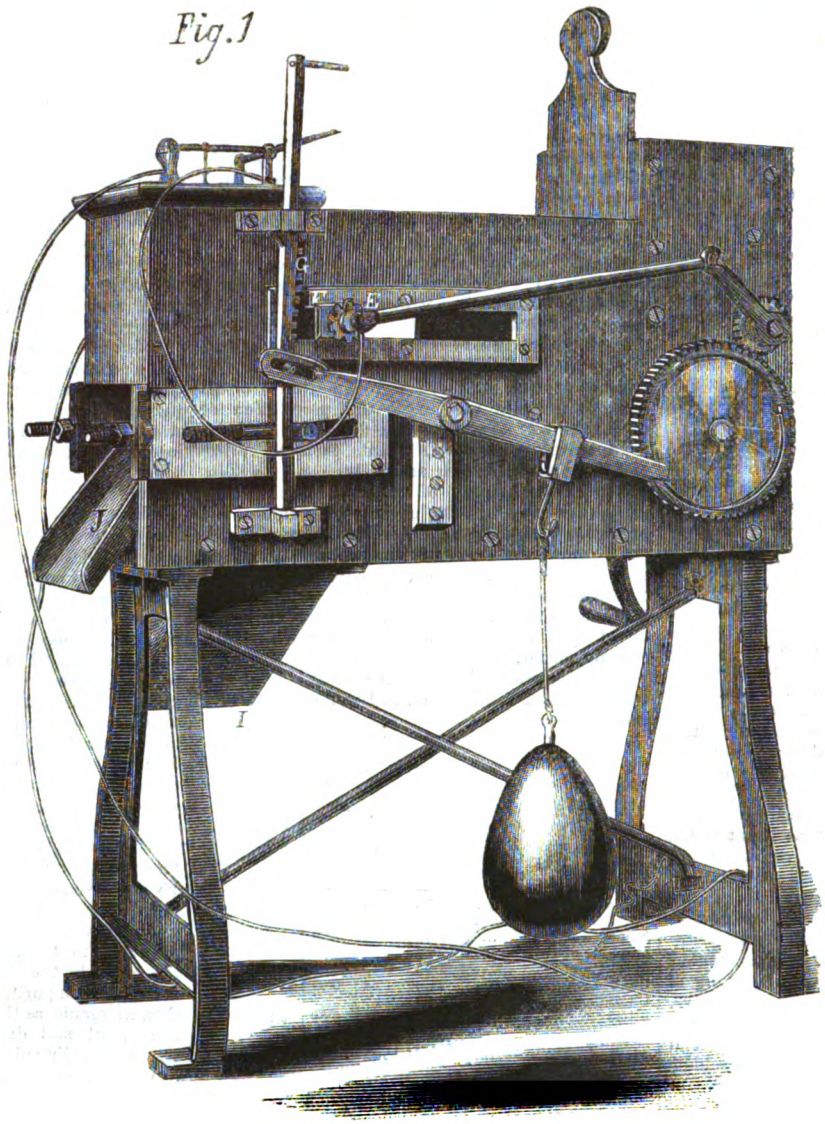
THIS most useful machine, is entirely original in idea and arrangement. It is for cleaning brass turnings.

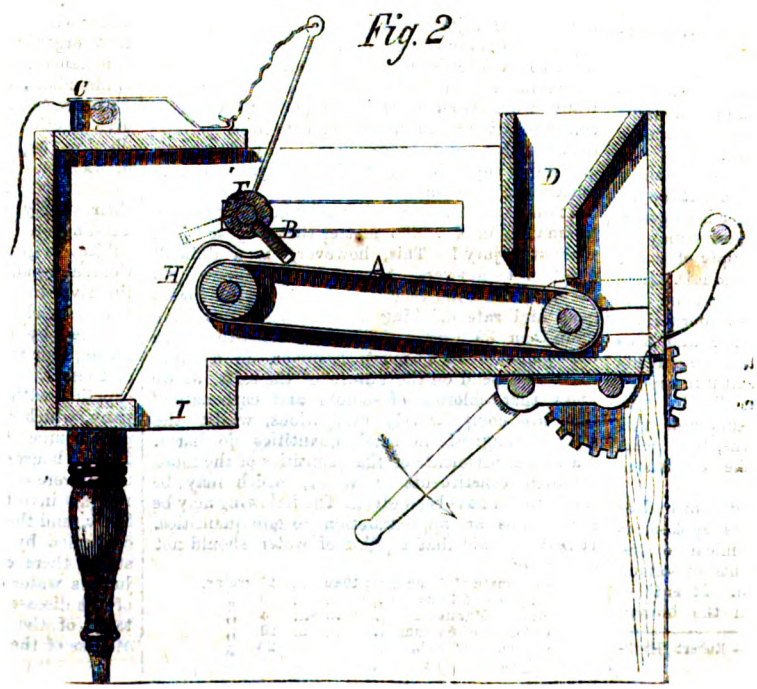
In shops where brass is worked in connection with other metals, the chips frequently get mixed with iron or steel. Brass is a costly metal, and all the chips are remelted to make other castings of. These turnings are usually cleaned by hand. A labourer takes a large horse-shoe magnet, spreads the chips out in a sieve or in a coarse cloth, and runs the magnet through the mass. All the steel and iron will adhere, and can be easily knocked off into any receptacle.

This machine does the same thing, but much faster and better than it can be done by hand. In detail, it consists of a frame, provided with an endless apron, A (see Fig. 2); a set of horse-shoe magnets, B; a battery, C, and mechanism for operating them. The chips to be cleaned and thrown on the apron through the hopper, D. The magnets then travel back and forth through them by means of the gear and pinion, E, and slide, F (see Fig. 1) to which the magnets are fixed.

At a certain point in the circumference of the wheel the slide, F, stops, while the magnets are revolved by the action of the rack, G, on the pinion E, and thrown over, with the steel and iron chips adhering, against a partition, H; the electric current from the battery above, which has charged the magnets, is then immediately broken, and the chips drop off, as they would from a stick or any other non-magnetic substance. The apron moves on and discharges the clean brass into a basket or box beneath the opening, J. The operation is then continued as before, until all the chips are cleaned. The refuse iron is taken out of the end of the machine through a shoot, J. A single-cup grove battery is sufficient to work the magnets. It will clean from three to five hundred pounds of brass turnings at a nominal cost, and may be worked by hand or by power.

The machine received a silver medal at the last Mechanics' Fair, Baltimore. It was patented on Jan. 25, 1865, by Julius Johnson, and is manufactured by J. Johnson and Co., engineers and machinists, No. 338, W. Pratt-street, Baltimore, Md., U.S.





THE LATHE AND ITS USES.*

THERE are two distinct kinds of work done in foot lathes—the useful and the merely ornamental. Both afford enjoyment and profit to those who practise them. The mechanic who earns his living by working ten hours a day in a workshop, does not care to go home and pursue the same calling in the evening; but he can institute an agreeable change in his life, beautify his dwelling, and cultivate his taste by the use of the lathe, and thus obtain ornaments that would cost large sums if purchased at the stores; or he may, indeed, make the lathe a source of revenue, and sell the product of his skill and ingenuity at high prices to those who admire but have not the ability to construct.

To many mechanics, even the lathe is merely a machine for turning cylinders or disks, or executing beads, ogees, scrolls, or curves of various radii, so that, after all, the work is pretty much alike, and ceases to be attractive. This is quite a mistaken view. There are no such goods in market as those made on lathes and peculiar tools used in connection with them—by lathes with traversing mandrils, with geometric chucks, with dome chucks, and compound slide rests. There are lathes that while one could chase up a five-eight bolt in them as well as on the simple pulley and treadle machine, are also capable of executing all sorts of beautiful things — vases with bases nearly square, or exactly square, with round tops and hexagonal bodies, with gracefully curved angular sides and bases fluted vertically; boxes with curious patterns, resembling basket work; in fact, any combination of straight and curved lines cut in the sides it is possible for an ingenious man to invent. Strictly speaking these are not lathes, for in order to do the things beforementioned it is necessary to use other attachments in

* Mostly compiled from *American Journals*.

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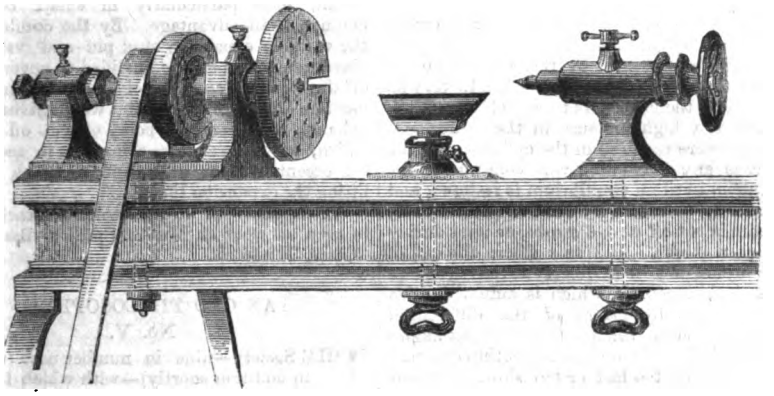
connection with them, so that the combination of them produces the results spoken of. There is, absolutely, an unlimited field for the genius of workmen to exert itself in designing patterns and executing work of an ornamental character.

All ornamental work resolves itself into movements of three kinds—angular, circular, and straight. From the combination of these with each other, the times where they merge and emerge, where a movement of one kind changes into any other, where on ellipse becomes part of a circle, where circles are generated across the circumferences of other circles, where these patterns are drawn over and upon each other without destroying the character of either—we say, by such movements, and many others which it would be confusing to follow, the most beautiful forms are made.

Or if the taste of the workman runs upon mechanical instead of artistic things, there are steam engines to be made, steam boilers to be spun up, of small size; in fact any piece or machine that can be thought of.

It is almost unnecessary to specify the innumerable kinds of work that can be done in a hand lathe, but the amateur who delights in metal turning may make trinkets of all kinds for his friends that shall vie in beauty with the best efforts of jewellers and goldsmiths. This, of course, is



dependent on the material used, the taste of the workman, and his originality of conception. Pins for ladies' wear can be made of boxwood and ebony glued together in sections, of all designs, and afterwards turned in beads and mouldings, or otherwise ornamented in a chuck, as will be shown hereafter. Sleeve buttons can be made of ebony and silver, ivory and silver, pearl and gold, or any combination that is desired. Chess and checker men also afford a chance to display skill. And besides these, special work of any nature is within the capacity of the machine. There is no family in this country says an American journal that would not find it economy to have a foot lathe in the house where the members have mechanical tastes—not necessarily the male members, for ladies use foot lathes in Europe with the greatest dexterity. Some of the most beautiful work ever made was by Miss Holtzapffel, a relative of the celebrated mechanist of the same name. If there are shovels to be mended, the lathe will drill the holes and turn the rivets. If the handle of the saucepan is loose, it will do the same. If scissors or knives want grinding, there is the lathe; if the castors on the sofa creak down, there is the lathe; if skates need repairs, either of grinding or of any other kind, there is the lathe. In short, it ought to be as much a part of domestic economy as the sewing machine, for it takes the odd stitches in the mechanical department that save money.

Let not the inexperienced reader, who hears of a lathe for the first time, be frightened at this array of terms, or diverted from the use of it, by the recital. In its simple form, as shown at the head of this article, it is readily understood, and, after a little practice, easily managed by any one, and after the first few weeks the amateur will realize the fruits of his application.

At first it had not even a continuous rotary motion, but the spindle was driven by a belt worked by a spring pole or its equivalent. The belt was rolled round the spindle, and the pole allowed to spring up; the spindle then revolved the length of the belt, or rope, for belts were not thought of, and the operation was repeated, the work being done only when the force of the spring pole revolved the spindle and the job the right way.

Foot lathes have, prior to the introduction of the engine lathe, been used on very heavy work. It is but a few years, comparatively speaking—not twenty—since cast-iron shafts, six, eight, and ten inches in diameter, were turned in such lathes. For all that we know to the contrary, many jobs, far exceeding this in size, have been thus executed.

In some shops there are still standing heavy oaken shears, made of timber twenty inches deep and four or six inches wide, faced with boiler iron, and in the racks above there are long-shanked tools with which the men of old were wont to do the work.

These lathes are never used now except for drilling holes, or for apprentices to practise on, but they serve to show what machinists had to do in olden times when there were no vice benches to sit on and watch the chips curling off the tool, as men do now.

Hand lathes are not in great favour in large machine shops. They are not used, or should not be, for any purpose except drilling, and then they are no longer hand lathes, but horizontal drilling machines. There is no simple work to be done on a hand lathe that could not be performed to better advantage and more cheaply on a machine constructed for the purpose.

Some large machine shops keep a hand lathe going continually cutting off stud bolts, facing and rounding up nuts and similar work. This does not seem profitable. A machine to do this work would do more of a better quality than hand labour could.

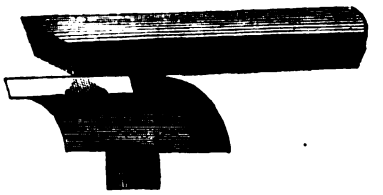


FIG. I.

The foot lathe—the terms hand and foot lathe are synonymous—is principally used at the present time by small machinists, manufacturers of gas fixtures, amateurs, etc.; men who do not work a lathe constantly, but are called off to braze or solder, or, perhaps, to fit some detail with a file. For these uses the foot lathe is one of the cheapest tools; for the same person that does the work furnishes the power also, so that a man working on a foot or hand lathe, as it is often called, ought to have first-class wages. Moreover, a first-rate foot lathe turner is always a good mechanic, for it takes no small degree of dexterity to perform the several jobs with ease and despatch and certainty. To always get hold of the right tool, to use the same properly so that it will last a reasonable time without being ground or tempered, to rough turn hollow places with a square edge, to chase a true thread to the right size every time without making a drunken one, or a slanting one, to make a true thread inside of an oil cup or a box—all these several tasks require good judgment, dexterity, and a steady hand. Of course where a slide rest is used the case is different. We allude specially to a cutting tool managed by the hand.

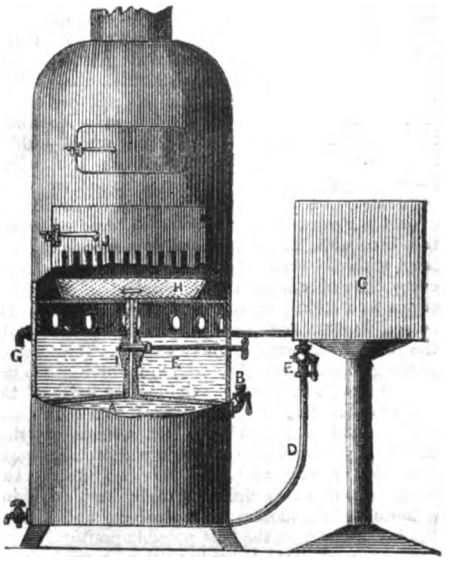
To all these things, however, it is necessary to have tools and good ones, or none. It is an old saying that a bad workman quarrels with his tools, but a good workman has a right to quarrel with bad tools if he is furnished with them, through chance or design. It is impossible to execute good work with a dull tool, one badly shaped, or unsuited to the purpose, and therefore, it is important to set out right at the beginning.

There is no tool more efficient in the hands of a good workman than the diamond point, Fig. 1, here shown. For roughing off a piece of metal, for squaring up the end, for facing a piece held in the chuck, for running out a curve, or rounding up a globe, it is equally well adapted. It may be truly called the turner's friend.

(To be Continued.)

APPARATUS FOR BURNING PETROLEUM.

The accompanying engraving (reproduced from the *Scientific American*) represents a plan for burning petroleum to heat water, either for generating steam or for culinary purposes, and is the invention of Mr. E. M'Kinney, of Clarksville, Tennessee, U. S. The petroleum is allowed to flow into a vessel containing sand or fireclay, on the surface of which it is ignited, and burns steadily without creating smoke. This sand supplies the



place of a wick in a lamp, and the vessel containing it is placed directly under the boiler, the oil being forced up to the pan by water pressure. A is the oil chamber, supplied with oil through the pipe D, and C is a reservoir filled with water, which communicates with the oil chamber by the pipe D, its flow being controlled by the cock E. F is a chamber above the oil reservoir, which is also kept supplied with water up to the outlet G, for the purpose of keeping the oil cool. H is the fire-pan containing the sand, and communicating with the oil chamber by the central pipe I. The bottom of this pan is slightly inclined from the centre, so as to diffuse the oil evenly all round, and is also furnished with grooves or channels for that purpose. There are holes, J, in the furnace door, and also

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air pipes through the bottom of the pan to admit air to the flame. In using this apparatus water is let into the chamber A, so as to cover the inlet pipe for oil, and the latter fluid is then filled in as before described; being lighter than the water it floats on the surface, until it finally rises through the central pipe into the sand-box or fire-pan. The sand becomes completely saturated with the oil, which burns freely when ignited, creating an intense heat. The danger from accidental explosion is prevented by reason of the oil being entirely covered or surrounded by water. This apparatus is claimed as being applicable to stoves for culinary purposes, and also to land or marine engine boilers. In the case of land engines the oil chamber may be removed to a distance from the fire-box; as in the yard for example, where a special building could be constructed for the purpose, and the oil pipe carried underground. On board ship the oil chamber might be situate in the hold, or near the keel, and the water reservoir on deck. The petroleum in this way might be kept in tanks covered with water remote from the fire, and where nothing but design could set fire to it. It could also be supplied to the fire without exposure to sight, touch, or smell.—*Practical Mechanic's Journal.*

KING, SMITH, & HOWELL'S (HARTFORD STEEL WORKS, SHEFFIELD) PATENT IMPROVEMENTS IN THE REVERSING AND EXPANSIVE WORKING OF STEAM ENGINES.*

(*Concluded rom page* 191.)

Let us now take the motion given to the valve by the shifting eccentric. This will equal the versed sine of one-half the angle described by the eccentric rod in moving to extreme positions, and which calculated numerically will give, $36 - \sqrt{36^2 - (4 + \cdot 866)^2} = 1\cdot 6$th of an inch, the link moving the valve more than seven times the distance of the shifting eccentric. This is the variation that would be given in mid gear, and cutting off at one-quarter stroke, the lead would not be so great, but the ratio may be very nearly found by taking a comparison between the tangent of 60°. And this amount, minus the tangent 30° (the angles referred to being ½ those described by the crank before the steam is cut off at ¾ and ¼ stroke) = 173 to 115, which will give a lead to the valve, cutting off at one-quarter stroke, of ·813 inches for the link, and ·12 for the shifting eccentric. Another improvement that may be mentioned, is the position of the hand wheel—which in men-of-war is of importance, as the whole manœuvring of the vessel during an action, more particularly on double screw engines, must depend upon the reversing gear. Ours is placed edgeways to a broadside, and in a very secure position, being level with the screw shaft and sheltered in almost every class of engine by the condensor. Another claim, and an important one, is its simplicity. As is well known, the great power required to move the valves of large engines requires the use of gearing to lift the links, which, involving the use of brackets and wheels, would fully balance the work in the casting that carries the eccentric and the four little cog wheels, so that we may say that the saving effected by the single eccentric in workmanship would be equal to two links, two eccentrics, and two eccentric rods, besides giving a more perfect motion to the valves, and placing the hand wheel in the best possible position.

The second part of our invention consists in an arrangement suitable to any engine in which a pair of governors is used, and which we employ to act upon valves in such a manner as to regulate the speed of the engine. Fig. 7 shows a plan of an engine of this description, a stud pin being used for working the valves, and which is attached to the sliding piece I. Upon I there are two feathers, which fit into the grooves of a spiral cut upon the face of the hand wheel, H, which fits loose upon the shaft. Now if, while the engine is stationary, the hand wheel is turned in either direction, the stud pin will be moved either further or nearer to the centre, and the point, if cut off, would be varied accordingly, as previously described; and if, whilst the engine was running, it could be made to run either faster or slower than the engine, by any means, a variable expansion motion would be produced. This is what we purpose to do by means of the pair of governors, which are driven from the engine by means of the strap, *a*, running to the pulley, *c*. Attached to *c* is a conned pulley, *d*, from which a small strap (passing through the strap guide, *e*, fig. 7), returns to the hand wheel, and which, during the time the engine runs at its proper speed, will make it run at the same speed also; but if any variation from the proper speed takes place, the governor will rise or fall, and shift the strap across the face of the conned pulley, making the hand wheel run faster or slower accordingly, so that, if the engine runs too fast, the stud pin will be shifted towards the centre, and the steam will be cut off earlier. If, on the other hand, the engine runs too slow, a contrary effect will take place, and the steam will be admitted later. When the engine is desired to be reversed, the hand, or a little block of wood, is pressed against the hand wheel, which, overcoming the friction of the small strap, will bring it to a stand still, while the engine will continue to run in virtue of the momentum it possesses, and the stud pin will be shifted across to the other side the centre of the shaft, and the valves will then be in position to run the engine in the contrary direction.

The advantages claimed for this arrangement are—greater simplicity and greater uniformity of speed than can be obtained by the ordinary governor, where the speed of the engines has to vary so much to enable the governors to cut off the steam, when there is a high pressure in the boiler, and but little pressure required in the cylinder. In the present case any fluctuation will continue to be operated upon until an equilibrium is restored, and the engine may be running just at the same speed, if the steam is cut off at 1·6 stroke, or used during three-quarter stroke. In cases where the end of the shaft would not be at liberty to be used, we employ a single eccentric, which is actuated upon by the governors by means of the differential pulleys, and a screw which is fixed at right angles to the crank shaft, and connected with the eccentric. If the engine runs too fast or too slow, the screw turns, and shifts the eccentric in the required direction. For a more detailed explanation and drawings, reference may be made to specification No. 3152 for 1864.

It should also be noticed that when the engine stops, by the steam being shut off, the stud pin will be as far removed from the centre as possible, for the speed having been gradually decreasing up to that time, the governors will have been operating to shift the stud pin in that direction, which would be of considerable advantage when you wanted to start again.

We have hitherto confined our attention to the notice of improvements as substitutes for the link motion, and which in every case give an equally good motion as the link, while where short rods require to be used, as has been shown, a very superior. But while the link, or the shifting eccentric, gives a correct inlet to the steam, the exhaust will not be correct; and the third part of our invention has reference to a means by which this may be accomplished, and which is equally applicable to the link motion, the shifting eccentric, or stud pin.

This will be explained by reference to fig. 7, in which H is a valve worked by the stud pin in the ordinary way, but into the interior of which a similar but shortened valve, P, is fitted so as to slide easily backwards and forwards in the valve, H. The sides of both valves are a little inclined, so as to allow the outer valve to always maintain a steamtight joint between it and the inner one. As is shown in the drawing, the valve, H, is just upon the point of returning in the direction indicated by the arrow, and if we follow this motion until H is just upon the point of admitting the steam, the valve, P, will be close against the end of H, and no exhaust will have taken place; but as soon as the steam is admitted, it will fill the port, and the full pressure of steam will pass up between the valves and drive P to the other end of H, which will give an instantaneous exhaust to the steam at the other end of the cylinder, A, which will always be dependent upon the time of feed to the cylinder, which the link or single eccentric gives correctly.

It might be suggested that the two valves would be driven together with so much force that a series of blows would be the result, which would quickly destroy the valve face, and render it impracticable to use; but a little consideration will show that such will not be the case where a lap is used upon the outside valve, which will always leave a little space beyond the port at the time that the valve is driven across, and, confining the steam, will form a cushion, which so checks the motion of the valves as to avoid any contact at all. In case the one valve should stick within the other at any time, either through standing for some time or from any other cause, we employ a simple arrangement of a little lever, which works backwards and forwards upon the back of the other valve, and which directly comes into operation should the steam fail to drive it across. The only condition required to be attended to when a valve of this sort is employed, is to make the width of the bridge of the valve face equal to twice the width of the port. By this means, instead of the steam being allowed to pass slowly away from the cylinder and exhausted at the wrong time, an instantaneous escape is given to the steam at the right period, which, more particularly in small condensing engines, is an advantage. By the combination of the variable expansive stud pin and valve combined, we get an engine qualified to reverse, to cut off the steam at any part of the stroke, through the medium of the governors, and which gives a perfect exhaust, whatever the point of cut off may be, which, with the engines at present in use, require six eccentrics, four links, and a weigh shaft for lifting the expansion links.

An engine, with all the motions attached, may be seen at work at Messrs. Smith's, Barton Iron Works, Hereford.

* Communicated by Mr. HENRY J. H. KING, Mechanical Engineer, to the *Practical Mechanic's Journal* for December.

AN OLD PHILOSOPHER.

No. V.

THE Society—nine in number now (we expect an addition shortly)—with which I have the pleasure to be connected has to express its surprise, but not by any means its disapproval of the course taken in amalgamating the MIRROR, to which every member subscribed, with the ENGLISH MECHANIC, to which they had also extended their support; and I am further commissioned to wish the new arrangement every success under its new auspices, and that its shadow may never be less.

To return to my philosopher, I may mention that many experiments, as carefully noted as the others, follow those already summarised, together with numerous corollaries, to which an interesting scholium is appended, from which that which follows is extracted.

In England Mr. Hawksby appears to have been the first person who instituted an inquiry into the proportion of the magnetic forces at various distances of the magnet from the iron. The method he adopted, which though very different from that adopted by Swedenborg, still deserves to be known, on account of the effects observable in adopting it. The description is to be found in Phil. Trans., No. 335; or in the Compendium, vol. iv., pt. ii., p. 295.

Mr. Hawksby took a quadrant the radius of which was 4ft., this he placed upon the ground, and in the centre of it a rotary needle. This needle, left to itself, stood at 0 deg. in the quadrant. He then placed a magnet in a piece of wood, so that its pole lay in the same plane with the quadrant and the needle, and might be moved round the margin of the quadrant from one degree to another, &c. The magnet, which weighed about 6lb., was of irregular figure. The experiments were made with two needles, the one three, the other six inches long; but he always found the shorter to be the better.

In the tables in which these experiments are recorded it is to be observed that the longer

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needle, at a distance of 9in., formed with the magnet an angle a little larger than the shorter needle at a distance of 3in. The shorter needle, at a distance of 9in., made an angle 9° less than the longer at the same distance. These paradoxes will be readily understood if the disproportion in the length of the needle is considered; for the point of the longer needle, at 9in. distance, was nearer the magnet by 1in. than the point of the shorter; and the point of the shorter needle, at 9in. distance from the magnet, was distant 5in. more than the point of the larger needle where the magnet was in the same degree of the quadrant. This disproportion must therefore be borne in mind. Further, the magnet, at 5 in. from the needle, made an angle of 2° with one needle, and of 2¼° with the other needle; but at a greater distance the change in the needle was not observable; so that the magnetic force extended itself to a distance of five feet, at which the proportions could be taken, but at a greater distance the force of the magnet was so feeble, that no observation could be taken with certainty.

SHORTER NEEDLE.				LONGER NEEDLE.			
Its distances from the magnet in inches.	Angles made by this needle at the several distances in deg.	min.	Differences.	Its distances from the magnet in inches.	Angles made by this needle at the several distances in deg.	min.	Differences.
3	87	0	180	9	87	30	345
6	84	0	330	12	81	45	570
9	78	30	570	15	72	15	1137
12	69	0	735	18	53	30	1100
15	56	45	795	21	35	0	660
18	43	30	630	24	24	10	380
21	33	0	540	27	17	50	280
24	24	0	360	30	13	10	180
27	18	0	270	33	10	10	130
30	13	30	150	36	8	0	90
33	11	0	135	39	6	30	75
36	8	45	105	42	5	15	65
39	7	0	90	45	4	10	40
42	5	30	60	48	3	30	30
45	4	30	40	51	3	0	25
48	3	50	30	54	2	35	20
51	3	20	20	57	2	15	15
54	3	0	15	60	2	0	0
57	2	45	15				
60	2	30	0				

Now, as by these experiments it is not possible to see with accuracy the distances of the magnet from the needle, the Royal Society requested the then celebrated Mr. Brook Taylor to institute experiments relative to the magnetic forces in another and a clearer manner. Mr. Taylor placed a needle in the centre of the former quadrant, and the magnet, the axis of which lay in a horizontal plane, he moved backward and forward from the needle in a line which was at right angles with the natural direction of the needle. Then, measuring the distance by a line between the centre and the magnet, he was enabled to table the following :—

Distances in feet.	Variations of needle in deg.	& min.	Distances in feet.	Variations of needle in deg.	& min.
1	81	45	6	5	35
2	58	0	7	3	30
3	30	0	8	2	20
4	16	0	9	1	35
5	9	20			

These experiments were made with the magnet of the Royal Society, but as there was not preserved a similar position of the line in which the magnet was moved towards the needle, though it was an indispensable requisite, not much of a conclusion, as Whiston observes, could be formed. Whiston's observations were conducted in a manner different from both Taylor's and Swedenborg's. He took two mariner's needles balanced on their pivots, one of which was four and a half inches, the other four feet long; also a spherical magnet 2 8-10ths inches in diameter. The South pole of this magnet he always opposed to the northern points of the needles, by moving the magnet towards the needle in such a manner that the latter formed a right angle with the directive line of the magnet. He then measured the chords of the arcs in which the needle declined from its natural direction, the lengths of which he assumed as the quantities to express the attractive forces. Instead of the chords he substituted sines,—the half of the chords,—and then he arrived at the following results :—

Distances in inches.	Degrees of declination.	Sines of half the arcs.	Distances in inches.	Degrees of declination.	Sines of half the arcs.
3	0	0	27	2	174
6	0	0	30	1*	160
6½	90	7071	33	1½	131
9	27	2334	36	1¼	109
12	13	1132	39	0†	73
15	9¼	848	42	0¼	65
18	6½	588	45	⅝	58
21	4½	392	48	½	44
24	3	262			

It would appear to be inferable that the proportion is exceedingly inconstant, being sometimes less than a duplicate proportion, sometimes a little greater, sometimes much greater. Whiston alleges that the ratio is the sesqui-duplicate, since in experiments of this kind a perfect geometrical exactitude cannot be obtained. "And this," remarks our Philosopher, "we should grant, were the allowance required for this inexactitude not too great, as appears here to be the case; for the discrepancy is too considerable, since the experiment in one case give, the proportion of $3\frac{285}{26}$ to 1 and in the other case of $6\frac{294}{131}$ to 1, so that these two must be reckoned as one and, the same proportion." "I do not see," he continues, "why we should not confess that no constant proportion obtains, rather then strain the experimental results to discover the existence of a proportion where nature denies it."

In pursuing this method of ascertaining the magnetic forces, a difficulty is latent. For the magnet or needle is acted upon by two forces distinct from each other—the one attractive, the other directive towards certain poles of the earth. In the present experiment the needle is operated upon by a force directing it to these poles. When the magnet is presented to the needle at varying distances, and deflects it from its previous direction, then by its attractive force it acts upon the directive force of the needle and deflects it, until the directive force, which acts upon the oblique position of the needle, finds its equilibrium with the attractive force of the magnet. Consequently, under these circumstances one cannot detect the quantity of the forces in the magnet and needle mutually attracting each other, only a something very different. For let us conceive a rotatory needle fixed upon its pivot, placed in the middle of any current of water, and observing a direction conformable to that of the current; let us also conceive that the point of the needle is, by means of a string attached to it, drawn sideways toward the bank in such a manner that the rope is always perpendicular to the needle; in this case, if the direction of the needle be made angular, not only does the string drawing with power act upon the needle, but also on the current, and has to overcome the force of the current running against it sideways and propelling it in a right line according to the determination of its course; the force of the incursion of the stream being the greater in proportion to the opposition of the direction of the needle to the current of the stream. The force drawing and inflecting the needle acts here, therefore, upon the needle and the directive force of current at the same time, and not upon the needle alone, inasmuch as it is now only a body to be moved. In like manner a rotatory needle, rubbing upon a magnet, is driven by the universal directive force towards the pole of the earth, and upon this directive force as well as upon the needle, the magnet in experiment acts with its attractive force, just as in the instance above cited the power by means of the intermediate string draws the needle in the stream. It is with this directive force that the magnet acts upon the equilibrium at different distances, and at the variously oblique positions of the needle. From these experiments consequently the degree of force with which two magnets are made to approach one to another, cannot be inferred—or of a magnet to a needle and to iron—solely by the attractive force. Still these experiments are not without their utility; because, supposing the needle capable of turning upon its pivot without friction, they show that the attractive force of the magnet acts upon the directive force at stated distances, according to the ratios above noted; and, when the attractive force of a magnet is known, then may be ascertained the quantity of directive force at any angle of the needle's obliquity by the common rules of mechanics.* With your permission I shall send you some further excerpts, though not, perhaps on exactly the same subject.

* 5-6th. † 5-6th.]

[*This "working" is given in page 307, vol. 1, of th Principia (London, Alvey, Bloomsbury-street), togethe with its necessary diagram.—ED.]

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

FURNACE BARS.

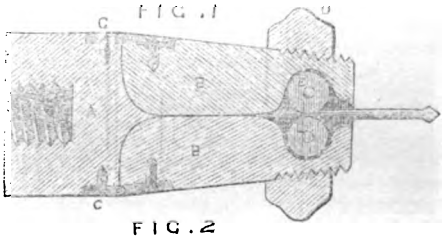
Sir,—Allow me to thank Mr. Mullholland and Mr. Jackson for their very timely and kind information about Furnace bars. Would either of them or any reader tell me how to construct the most simple and inexpensive self-regulating damper, also the most simple and inexpensive way to consume smoke. H. PRITCHARD.

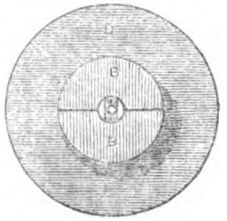
BORING COLLAR AND DRILL CHUCK.

Sir,—I beg to send a small contribution to the enlarged edition of your truly valuable journal. I have taken it from its first number, and as an amateur only in mechanics, have been highly gratified by the information so largely given on all branches of mechanical and scientific pursuits. Allow me to thank you for your kind insertion of the few contrivances I have sent, and to express a wish that a prosperous new year will be enjoyed by your ENGLISH MECHANIC. THOS. E. MERRITT.

Fig. 1.—Drill in position.

Fig. 2.—End View, showing V-grooved nipping wheels.





DESCRIPTION OF DRILL CHUCK.—A is the body, B B are the two semi-cylindrical jaws, hinged to the body with hinges C C. The jaws are formed by turning a cylinder, hinging it as shown above and below, and then by cutting with a fine fret-saw, you get the semi-cylindrical jaws B B. The jaws are coned off towards the ends, and fitted with a nut D. The peculiarity of this chuck is, that it is fitted with two small V-grooved wheels E E, which are sunk into the inner surfaces of the jaws, a small portion projecting so as to nip any sized drill-shank introduced, when the nut is turned. It will be seen that the drill is always held central.

IRON GIRDERS.

Sir,—Will you allow me to point out a small error in your last number, in the article, "Kirkaldy's iron and steel testing works?" Referring to the patent girder of Messrs. Phillips you remark "its peculiarity consists in the flanges being rolled solid instead of being riveted as heretofore, etc." There is neither novelty nor peculiarity in this form of girder. For the last 10 or 15 years, rolled iron girders, flanges and all in one piece, have been in use among Engineers for the cross girders of Railway bridges and a variety of other purposes. Any of the leading iron firms of England will supply rolled girders as per sketch up to 12 inches in depth and of a proportionate breadth of flange. THOMAS CARGILL, C.E.

SUBSTITUTE FOR SPIRITS OF SALTS.

Sir,—It is not generally known that Sir William Burnett's disinfecting fluid is a good substitute for spirits of salts, and answers the purpose much better for iron work (I cannot say for lead). I have seen it used extensively in an Engineer's shop, and several Plumbers I know use it very much in well work, with iron pipes. I can vouch for its superior qualities, and it is one-twentieth the cost. TURLING.

MAGNETIC ENGINE.

Sir,—E. Maddock states in your last impression that he is about constructing an electro-magnetic engine. As I am about to do the same thing I should much like to

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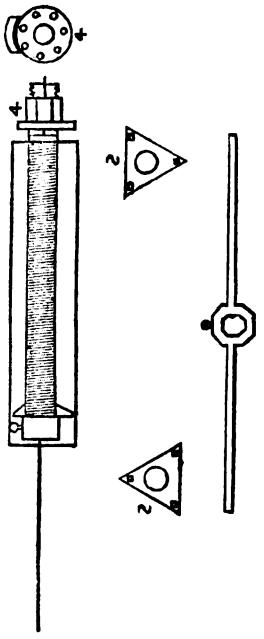
communication with him either through your friendly pages or privately.

My idea is that the most power will be obtained by placing the magnets at, or near, the periphery of the fly-wheel; it seems to me that if the wheel be arge, the magnets numerous, and the contact made and broken frequently, the most power will be gained that the battery is capable of producing. My magnets will be made of *uncovered* wire; in spite of what has been said to the contrary I believe much loss is occasioned by insulation, excepting between the helicies, all my experiments tend to confirm me in this opinion. T. T. PARKINSON.

NEW TOOL.

Sir,—I have sent you a pen and ink sketch of a Tool which I registered in the 1851 Exhibition. I have never seen any so handy and I make the public a present of it through you.



The Tool itself is 20 inches in length, if much longer it would be too heavy for one hand.

The three bolts or bars which are riveted in *square* holes in the two triangular pieces are ⅜in. diameter, the triangular iron top and bottom ⅜in. thick at bottom and rather thicker at the top where the brass nut rubs. The screw is 1¼in diameter, and was made out of a piece of hoop L iron 3½in. wide and ⅜in. thick, welded on a ⅜ rod of round iron and ⅜in.

The brass nut which fits the hollow screw, was cast on a bolt a little smaller than the screw and turned in my lathe to fit the same; I can lift 4 tons with it easily and pull No. 1 wire asunder like thread if I like.

N.B.—This Tool would be handy to rifle gun barrels—I have used it for that purpose myself.

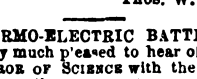
THOS. W. RICHARDSON.

THERMO-ELECTRIC BATTERY.

Sir,—I am very much pleased to hear of the incorporation of the MIRROR OF SCIENCE with the MECHANIC. It will be a great boon to those amongst our working mechanics who may have a turn for Chemistry or Photography, &c. I for one wish you every success, and will do all I can to help you on with your Workman's Excelsior.

I must not take up your valuable time however with irrelevant matter, so to business. In reply to "Chips" wishing to know how to form a Thermo-electro battery, I give a few extracts.

The simplest form of this kind of battery is made by connecting bars of bismuth and antimony thus—



bismuth being the positive pole when heated at the point of junction with the antimony, but the negative pole if the point of junction be cooled.

Watkins' massive thermo-electric pile consists of an alternate series of square plates of antimony and bismuth having their upper and lower edges alternately soldered together, so as to form a composite battery, and packed into a frame with non-conducting matter, so as to leave *the upper and lower surfaces of junction exposed* when the *upper* surface of the pile is cooled by filling the upper projecting portion or *ledge* of the frame with pounded ice, and the *lower* surface heated by radiation from a rectangular piece of red hot iron placed on a small iron stand beneath, a thermo-electric current is generated sufficiently intense to exhibit the ordinary voltaic effects of light, heat, electro-magnetism with its rotations and induction.

This battery would be very costly, however, which I suppose will be a great drawback; perhaps a few series of the simple form first mentioned, using bars of copper pyrites instead of antimony and connecting the poles with a series of the secondary batteries so graphically described by "Anion" in No 41 of the MECHANIC, third column, page 172, may answer "Chips's" purpose.

If "Chips" is quite a novice in electrical matters he had better no attempt to make his own apparatus till he has "read up" the subject. He will find a good guide in Golding Bird's "Natural Philosophy," published by John Churchill, New Burlington-street.

I am about to institute a series of experiments myself, in a plain sort of way, upon Thermo-electricity.

THOMAS PEASE.

[We hope that our obliging correspondent will favour us with the result of his labours.—ED.]

ELECTRICAL MACHINE.

Sir,—If any of your scientific correspondents can help me out of a difficulty I shall feel extremely obliged. I have lately constructed an Electrical Machine, but from some cause or other it will not act, though I feel pretty confident it is perfect in all its parts. It is made with a cylinder 18in. long, 11¼in. in diameter. The caps are cemented in, and it is supported on a mahogany stand of well dried wood. The conductor is of tin (japanned), supported on two glass legs. This conductor is 12in. long, 4in. in diam. and is furnished with brass pin-points, each about ⅛th in. apart. The cushion is made of felt carpet covered with two layers of silk, and is supported by a glass pillar. Owing to the glass cylinder not being perfectly true (it is rather concave in the centre), I have put two steel springs at the back of the cushion to ensure a certain pressure on the glass. The silk floss comes to within an inch of the pin points. I have had this machine standing for hours before a fire, and cannot draw a spark from it; of course there is proper amalgam on the cushion. There is only one reason I can give, for I cannot suppose the closeness of the pin-points can in any way affect it and that is, in order to prevent any breakage of the cylinder from the expansion of air when before a fire, I drilled a small hole through one of the caps. I find that there is always a little moisture inside the glass, even if it has stood half a day in front of a good fire. This I cannot get rid of. I am aware that damp is fatal to the success of any electrical experiments, but there is so little inside the glass, and the glass itself has been turned when quite hot, that I greatly wonder at no effect whatever being produced from it. I shall be glad if one of your numerous friends can give me a hint or two in the matter—indeed it may be useful to others. A. N.

SILVERING MIRRORS, &c.

SIR,—Allow me, through the medium of your valuable paper, to express my thanks to Mr. Petitjean, for his kind information with regard to the silvering of mirrors, &c.

I see at once the simplicity and cheapness of his process, and think it far superior in those points to Drayton's. I have referred to the *Chemical Gazette*, in a back number of which I find a notice of Mr. Petitjean's process. I also find that aldehyde, salicylous acid, &c., have the property of reducing silver from its solution.

I am glad to see another letter from Mr. Tawse, though I am sorry to find that he misunderstands me. I do not for a moment deny the practicability of his idea, but merely state that, as he explains it, it is encumbered with several difficulties, as insulation, corrosion, &c., which, though in themselves small, would, I am afraid, sadly interfere with the full development of the electro-motive power. I still adhere to my statement that coal is at present a far cheaper method of raising power, but I, with Mr. Tawse and others, hope that the minor difficulties will be overcome, and that we shall yet have fleets of vessels propelled by electro-magnetism.

I must also express my thanks to Mr. Tonkes for his kind, though brief, information respecting the coupling of Bunsen's pile for quantity; and I find it answers perfectly.

I am delighted with the new style of the *English Mechanic and Mirror*, and I wish it every success.

VINCENT C. DAVIS.

OUR SUBSCRIBER'S NOTES AND QUERIES.

COMBUSTION.—Can any reader inform me of a plan by which I may get rid of the smoke which gathers on a flask after being heated for some time? I use a common Argand burner. I find that the soot gathers very thick in about a quarter of an hour. I use the gas which is burned in the house.—JAMES ROBERTSON.

ARTIFICIAL PATENT FUEL.—Can any correspondent describe the most usual or best mode of making artificial or patent fuel from coal dust or slack. Has there been a patent taken out forsuch a process?

CHUCKING.—Can any reader inform me as to the best method of chucking small work, such as brass or iron screws about half an inch in length?—F. E. M.

STEAM BOILER.—Will any reader inform me what are the advantages of a dome on the steam boiler; as we are about to have a 3-horse boiler made and the maker we have applied too said it is all moonshine putting one on?—W. BERRY.

LACQUERED WORK.—Can any reader inform me the best way of cleaning and restoring lacquered work? and also the best way of applying lacquer to brass articles?—S. STEVENS.

AIR GUN.—Would any reader oblige me with the description of an air gun?—C. N.

LIME LIGHT. Can any reader inform me where the flavith lamp is to be seen, the price, and whether it fulfils all that is said about it; also, if there is any plan for using lime with an ordinary paraffin lamp?—CALLUM PRIS.

VENTILATION.—Will any reader inform me of a good and simple method of ventilating school class rooms 15 feet square? We have an air brick in the outer wall near to the ceiling, but it does not answer the purpose; no foul air appears to go out, only cold air comes in. A slight sketch would, if convenient be of service.—VENTILATOR

I should be obliged to you or any reader who may have had the opportunity of seeing Mr. Kennan's fret saw for a further detail of rocking shaft, vibrating arms &c., above the table, and if any of your readers could inform me how wood rings can be turned linked together.—T. H

JAPANNING.—In reply to Flanders Owen, in No. 49, in "Notes and Queries," respecting japanning tin trunks, I shall esteem it a great favour if he will oblige me with the plan, and what kind of stuff he uses.—BRIGH HARKER

CYLINDER.—Can any reader inform me where I can get an oscillating cylinder with piston and rod complete, say 2 inches diameter, and 4 inches stroke, also the price of one either in brass or iron?—THOS. CROWE.

TIN TRUNKS.—Will Flanders Owen be so kind to as send me, through your columns, his process of japanning tin trunks, also instructions how to construct an effective stove for the purpose?—JOHN ROSS.

MUSICAL BOX.—Will any reader instruct me to contrive a clockwork musical box, also how to silver copper reflectors?—GODFREY.

VELOCIPEDES.—In Vol. II., No. 38, an Amateur tells us that he has a velocipede as near perfection as possible. I shall be glad to see the description of this in your paper.—T. BRISTOL.

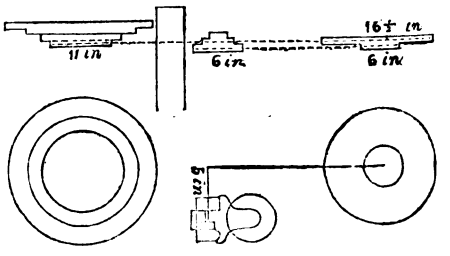
[We expected to have received the drawings from Amateur long before this, but have been disappointed.—ED.]

FRET SAW.—I am greatly obliged to Mr Merritt for his information respecting the fret saw, but he omitted to mention how to make the saw, and set the same, as they are usually made at home, and I do not understand how the teeth are cut in the first instance.—JOHN HERBERT.

Perhaps some of your correspondents can inform me the best form of a moulding machine (vertical and cutter), thickness of wood ½ to 1½ inches, the probable cost, where they can be obtained, and if it could be driven by hand power?—J. H.

MILL FOR GRINDING COLOURS.—Will any correspondent let me know whether the machine mentioned as paint-mill or colour-mill would be suitable for grinding printer's ink? Can it be easily cleaned, so as to suit for grinding different colours, and, if so, who are the best manufacturers, what are the prices, and where may I obtain one or two?—JNO. LANGLEY

LATHE MOTION. Can any reader inform me of a cheap and easy method of getting a slower motion to my lathe. The lathe is a metal one 4½ centre. The crank wheel has three rates, and the diameter of the smallest is 11 inches. The pulley has three rates, and the diameter of the largest is 6 inches I have made the motion slow enough by putting another rate on the crank wheel of 4 inches diameter (one third less than diameter of pulley), but then the cut I can take is very small, and the band, however tight slips on wheels with very slight increase of pressure at about 1½ inch from the centre. My own idea has been to fix a spindle overhead with a wheel having two rates 16½ inches



and 6 inches diameter. By taking the motion from the 11-inch crank to the 16½-inch wheel, and then transmitting this speed from the 6-inch to the 6-inch pulley, I should should get the motion slow enough. Is there any objection to the length of band? Again, if I brought the spindle forward so that its centre would be about 5 inches in advance of the centre beds of lathe, I could give motion to the wheels on handle of slide-rest, so as to make it self-acting. Is there any objection to this? (The rough sketches I send will assist to explain my meaning.) Any hints or information from a subscriber will greatly oblige.—F. G. B.

PITCH OF SCREW PROPELLER.—I wish to obtain the pitch of a screw propellor which I have. Can any subscriber inform me how to proceed, and also how to set the same out on paper?—J. D. S.

PRINTING MAGIC LANTERN SLIDES.—Can any valuable subscriber inform me how to paint magic lantern slides, so that any colour will appear clear and transparent, or the chemicals used?—VIRGIL

A MACHINE TO BLOCK THE FRONTS OF WELLINGTON BOOTS.—Can any of your correspondents give a description of one, with drawing if possible?—S. L

BOILER MAKING.—Can any correspondent inform me of any work that treats expressly upon boiler-making? I have Templeton's Workshop Companion, but have found the length given for angle iron hoops in some instances incorrect. I want a work that will enter minutely into the subject, with the details.—DAVID WOOD.

ELECTRO MATRIX.—If any kind correspondent of the ENGLISH MECHANIC can inform me what material is most suitable for taking moulds from printing surfaces (metal or wood) for electrotyping I shall feel greatly obliged. It must possess the following properties:—deliver freely and yield sharp and faultless moulds, unaffected by immersion in the copper solution and unaltered by continued use. I have read Smee's work, Walker's, and others of authorit

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on electro manipulation, but find practical difficulties and objections in the instructions given for moulds to suit trade use. I have tried bees-wax, gutta-percha, gut a-pe cha and marine glue, white wax stearine, spermaceti, and have used combinations of the above with resin, flake, white Venice Turpentine, and so many other things that it would occupy too much space to enumerate, and I cannot arrive at perf ction. -ESSAMICUS.

MICROMETER. Many thanks to F. R. A S for his kind attention, but his answer does not meet my present difficulty. What I inquire for is the practical details for the construction of a wire position micrometer, with two movable wires (in consequence of which I apply the term double) consisting of general dimensions and arrangements of its parts as being appropriate for a reflector of 13 inches diameter, 10 feet focal distance. In regard to the mountings, the simplest lineal drawing of Mr. Lassells would be sufficient for my purpose, and would be very acceptable. Farther, in regard to the Luminous Image Micrometer, does it consist of what is called a Coddington eye-piece, with the third lens bisected; and does the semi lens move in a plane as perpendicular to the axis, or in a curve like the heliometer? Which of the two above micrometers have the most practical va ue? An answer from the Fellow of the R.A.S. would be valued by—T. W. B.

WOOD DYES.—Will any reader oblige me with stains for the following woods:—Rosewood, walnut, satinwood, light and dark oak?—T. K.

TAKING A PICTURE.—Will some of your readers describe to me succinctly the chemical changes which occur when taking a picture in the following order:—

1. I put a plate in the bath.
2. I expose it.
3. I pour something on it and I see a picture.
4. I fix it.

5. In preparing a negative I put on a little more silver solution. Is that anything like the depositing process of plating only without the galvanism?

Why should iodizing solution be necessary to plain collodion?—M. C.

BOILER PRESSURE.—Will some reader inform me the pressure of steam required to work a cylinder of 1½ inch bore and 1½ inch stroke, also the sized boiler preferable?—IGGONYAMA.

GOLD AND SILVER SOLUTION.—Can any reader inform me how to make gold and silver solution, and whether it can be applied to steel, and how to use it?—YOUNG MECHANIC.

GEAR.—Can any reader inform me how I can fix reversing gear on an horizontal engine, and also the simplest form of pump for supplying a ½ horse-power boiler?—C. A. WOOLNOUGH.

I beg you to favour me with a short space in your valuable journal in order to thank Anion for his remarks concerning a secondary battery, which he inserted in the Christmas number. As he made an allusion to one of a more powerful description, I should feel particularly obliged to him if he would, through your columns, kindly acquaint me with it?—GALVANI.

WHITE JAPANS.—Can any correspondent inform me the best and easiest method of preparing a small quantity of white Japan quick drying?—EQUIMOUX

BOILER.—Can any reader give me the size and drawings of an upright boiler for a one horse engine, to be without brickwork?—ECCENTRIC

CONDENSING APPARATUS.—Will any reader oblige me with a plan and description of the newest-sort of condensing apparatus?—GOLDSMITH.

ECCENTRICS.—Will some reader oblige me with a plan of eccentrics used on locomotives, and how to reverse them?—GOLDSMITH.

CEMENT.—Can any reader oblige me by informing me how to make a really good cement for uniting meerschaum?—GUNMAKER.

ELECTRIC.—Will Mr. Tonkes explain the helix of an electrical machine? I wish to know if the insulated wire is wound on each bobbin separately, or both at once—if separately, are the wires connected, and where?—J. STEWART.

THE TANNING PROCESS.—Is the process known as the Tanning process the most convenient and best for an amateur in dry plate photography, and do they make good negatives?—TAN.

PHOTOGRAPHY.—In taking a positive photographic picture of a steel engraving after the ordinary iron developed, I washed over the plate with a weak solution of iodine, and when fixing the picture with cyanide of potassium I observed a beatiful blue appearance, to secure which, I immediately washed the plate. Many professional photographers to whom I have shown it consider it to have a very good effect. I have tried to produce the same on paper, but without success. I have had the picture on glass now about two years, and it still has a very pretty and novel appearance, and if any of your correspondents will tell me how to secure the same on pho prints, I shall be obliged—IODINE

ORGAN, PHOTOGRAPHY, &c.—Will any correspondent answer me the following four questions:—

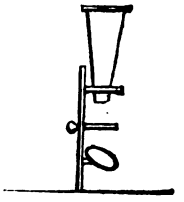
1. What is the principle of Mr. Barker's invention (of Paris)? The end obtained is the pulling down of the pallet in the windchest of an organ, so as to avoid a heavy touch upon the keyboard. Is it done by electro magnetism, or how is electricity made subservient to this end?

2. I remember seeing something of an invention in the *Mechanic's Magazine* a long time since about a series of small electro magnets mounted in the form of a pile with sheet India-rubber betwixt each mutually attracting each other, comprising the India-rubber, and thereby pulling down a crank?

3. A friend of mine has been in the habit of developing with iron, intensifying with pyrogallic and silver fixing with cyanide, and mixing all the waste solutions with the washing water together. A bluish coloured precipitate has been produced. Is it of any good, and what is it?

4. Is there any substitute for the expensive transfer varnish sold at the diaphanie shops, and is there any method of treating an ordinary piece of wall paper, engraving, or coloured print, so as to get the colour and picture off the paper on to a piece of glass?—JOHN TAYLOR.

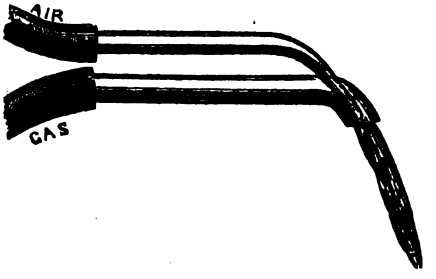
POLARISING GLASS.—Will some reader tell me how to make a polarizing apparatus for my microscope? It is a fixed perpendicular one of this sort:—



I have seen very good amateur ones made with paper casing. YORK.

REPLIES TO QUERIES.

AMATEUR'S GAS BLOWPIPE.—This may be easily constructed by any person; all that is requisite is a common blow-pipe and a piece of brass tube about 3-16th inches in diameter. Bend the tube slightly at one end, and at the shoulder make a hole so that the small end of the blow-pipe may pass through into the larger tube, to come about flush with its end. Solder the joint to make it air-tight, and fasten pieces of vulcanized India rubber tube of any convenient length, to each of the other ends of the brass tubes,



and your instrument is complete. Let gas pass through the larger tube and ignite it, now blow through the blow-pipe, and by regulating the gas flame you can easily obtain any degree of heat you wish, as well as a very steady flame of any shape. No one who has once used it will willingly go back to the single tube or ordinary blow-pipe. The fine end of the blow-pipe should be about the centre of the larger or gas tube.—CYCLOPS.

Mr. G. W. WALTON'S VELOCIPEDE.—I am fully convinced that Mr. Walton will not "fire the river at London," as he has failed even to kindle a spark of enlightenment or information to my present slender knowledge of velocipedes. I shall feel extremely obliged if your correspondent will be more explicit if he should again attempt to make any further observations. I am totally ignorant of its entire principle, and hope he will favour me with some more comprehensible remarks, as I am greatly interested in velocipedes, and should like to construct an efficient, and as serviceable a one as possible.—S. POOOCK.

BATTERY.—I have no doubt that many of your readers feel obliged to Anion for his contribution to your Christmas number, and I trust that the promised information respecting the rest of the apparatus in connection with the "secondary battery," &c., will very shortly appear in the excellent ENGLISH MECHANIC.—J. R.

THE SAFETY VALVE.—For weeks past, a question upon which I have once or twice touched, but have from want of time been unable to deal with thoroughly, has been outstanding, and hitherto dealt with by your correspondents as one of an entirely different character from that which the originator of the problem evidently intended. Having just now a few moments leisure, I employ them on this subject, as I consider it one of the most important that an English mechanic can take an interest in.

In your number 31, page 52, T. G. Maugh asks the apparently simple question, "What is the method of ascertaining the pressure of steam a boiler can bear by the safety valve?" This question, simple as it may appear, is one requiring some enquiry, and has evidently been misunderstood by all who have attempted to reply to it, in fact if it were not for the results of Mr. Wm. Fairbairn's labours, nothing scarcely worthy of an answer could be given to the question. Thanks, however, to his energy, and really wondrous devotion to engineering as a science we have transmitted to us a formula so simple that none can say misunderstand, while its accuracy has been put to a test that seldom falls to the lot of formula founded upon tentative operations. In order, however, to use his formula it is necessary to find the strength of the material of which the boiler is to be composed, which can only be done by experiment prior to the boiler being made upon a portion of each plate, and even then we must assume the plates to be homogeneous, a thing rarely practically realised, yet sufficiently so for practical purposes. If now we assume that—

D = the internal diameter of the boiler.
L = the length submitted to bursting pressure.
l = the length after subtracting the part punched out.
P = the bursting pressure.
T = tenacity of material in lbs.
t = thickness of plate in parts of an inch.

the force to produce rupture longitudinally must be equal to D L P, and the resistance opposed to this force is equal to the area of material in the longitudinal section multiplied by its cohesion or 2 t, l, T. and if rupture takes place, the bursting pressure is at least equal to, but must be greater than the resistance of the material; yet let us consider it equal and the equation becomes—

$$D L P = 2 t l T \quad \text{hence}$$

$$P = \frac{2 t l T}{D L}$$

In this simple formula your correspondent has all the information he can possibly require to suit his purposes, and its accuracy was most wondrously tested in the unfortunate event which occurred at the Atlas Works, Manchester, when plates ⅜" thick, gave way under a pressure of 120lbs. per square inch, and Mr. Fairbairn, who was called in as evidence, showed clearly from the above formula, in combination with experiments subsequently made, that the explosion was inevitable. It is quite true that the *Times* in reporting Mr. Fairbairn's evidence, made 20 tons = 45,000lbs, but since reporters cannot always be mathematicians, and the error did not materially affect the result obtained, perhaps it would be better to accept the theorem gratefully, and bury the humbugs of reporters in their native soil—oblivion.—WM TONKES

BRONZING.—I tender to Give and Take my best thanks for his detailed account of how to rebronze my coffee pot. I have a forge at command, and will take the first opportunity of trying his process.

ERROR OF PRINTER.—In perusing your notices to correspondents, I find you have been mistaken in putting level wheel instead of bevel.—JOHN MELAN.

PHOTOGRAPHY.—Lenox, in No 41, is informed that the best artificial light is the magnesium wire, sold at about 6d. per yard. The following is a list of the chemicals required in taking a collodion photograph:—Collodion, crystallized nitrate of silver, protosulphate of iron, glacial acetic acid, nitric acid alcohol, pyrogallic acid, citric acid, hyposulphate of soda, black varnish, lulirit varnish. For full information I should advise Lennox to purchase "The Principles and Practice of Photography," by Jabez Hughes, 379, Oxford-street, W.—J. A H. (Wolverhampton).

DYE.—In answer to Parian, he can make a good ebony dye by giving his work two or more coats of logwood, and two coats logwood and green copperas.—T. H.

CUTTING SCREWS IN WOOD.—In answer to X. Y. Z., he can get a tap and engine for cutting external and internal screws in wood at any tool-maker's shop, ranging in price from 4s. to 30s. according to size.—T. H.

TRACING PAPER.—In answer to J. H. Raven, he can make a good tracing paper by thinning down Canada balsam with turpentine.—T. H.

THANKS.—Allow me through your useful paper to thank T E. Merritt for the trouble he has taken in describing his fret saw, for which I tender him my sincere thanks.—BUTT JOINT.

RENDERING IVORY FLEXIBLE.—In reply to J. M'Murray in No. 41, "Ivory may be rendered *flexible* by immersion in a solution of phosphoric acid (sp gr. 1 13) until it becomes translucent, when it is washed in clean cold soft water and dried. In this state it is as flexible as leather, but gradually hardens by exposure to dry air. Immersion in hot water will restore its softness and pliancy."—Cooley's Cyclopædia.—J. K.

VELOCIPEDE.—I beg to inform Gladiateur that I have a double velocipede in course of construction, but not quite finished, which I think will be quite equal to the best, and far superior to most. I have made a great improvement in the treadles, and my improvements can be seen any time by applying at J. Pedrick's, 27, Sandford-street, Portman Market. I would advise N. J. W. by no means to use wooden wheels, iron wheels are far preferable if well made. You can combine strength with lightness, which is absolutely necessary for running on roads from twelve to fifteen miles an hour. I have an iron wheel I can show any enquirer.—R. J. P.

VELOCIPEDE WHEELS.—For the information of N. J. W. I send the sizes of a pair of hind wheels I have made for a velocipede. The height 4 feet, centre 5½ inches long, 4 inches diameter, made out of a good piece of elm; spokes flance wood ¾ inch on face, 1½ inch deep, ten in each wheel. The best sort of Felloes are half rims of hickory, which he can get bent at the coach timber-bender's, the sizes as stated by T. E. M., with a ¾ ⅜ half round tire. The reason why half rims are best is because there are only two joints, instead of 5, 6, or 7, according to the number of spokes. I shall be happy to give N. J. W. any further information should he require it.—ED. ADAMSON.

PREPARING TRACING PAPER.—J. H. Raven asks for a receipt for preparing tracing paper; I extract the following from Mr. Grier's *Mechanic's Calculator*. Mix equal parts of turpentine and drying oil, and with a rag lay it on a sheet of good silk paper, allowing the paper to lie by for two or three days to dry, and when it is so it will be fit for use. To use it lay it on the drawing to be copied and the prepared paper being nearly tran parent, the lines of the drawing will be seen through it and may be easily traced with a black lead pencil. The lines on the oiled paper will be quite distinct when it is laid on white paper.—BUSBLEY.

ARTIFICIAL MAGNET.—In answer to Telegraph Clerk respecting an artificial magnet, he does not state what power he requires or what use he intends putting it, but I will give the dimensions of one I have lately fitted up and that will guide him in his choice. Take a piece of inch bar (round of course) thirteen inches long and bend it into the form of a horse shoe with the ends strictly parrallel, then get half a pound of covered copper wire, No. 16, and commence to wind on, the power may be increased by covering the iron first by winding on strips of silk so that the surface of the iron is protected from contact, leave a free end of about 3 feet for attachment to the battery and begin about half or a quarter of an inch from the end, and fasten the first turn with a piece of pack thread, and proceed to wind the wire on as closely

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neatly as possible; it does not make any difference whether it is coiled to the right or left, as it does not matter which is the north pole, and go right round the magnet, fastening the other end same as the first, the coils round the bend will be a little open at the outside or it will not come square on the second limb. You may then attach it to the battery and see if all is right, if so, varnish all over with red sealing wax dissolved in spirit, and it is finished; but connecting one end of the wire will not be sufficient, as it is necessary that both ends of the wire should be attached to the battery to complete the circuit, or the magnetic influence will not be set up. With this magnet I can suspend 28lb., using a single pair, zinc and copper, same as I use for Electrotype plates 6in. by 3½in., but an increase in the battery power would make it very much more powerful. If Telegraph Clerk would call at my house I should be happy to show him my magnet and possibly interchange of ideas might be advantageous to both. The wire is sold at Knight's corner of Foster-lane, City, price 3s. 6d. per lb.—G. HUDSON.

60, Park-place, East-street, Walworth.

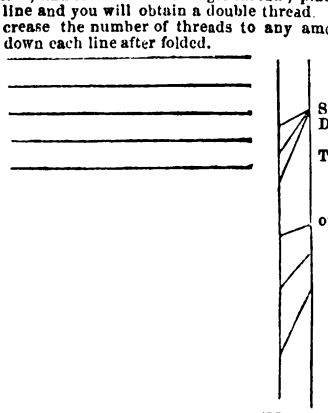
SCOTCH MECHANIC enquires about a turbine; I have one, made by the North Moor Foundry Company, one man's power with 15lbs, pressure to the square inch of towns water. It has not been used. I have it to dispose of at much less than it cost me. If Scotch Mechanic addresses E. H. H., *Morning Telegraph* office, Hull, he can have full particulars by post.

TELESCOPE, &c.—In reply to A. M., substitute a concave eye glass, and you will have a telescope suitable for viewing terrestrial objects, let it be same diameter and focus as the convex one removed. I cannot give you instructions to grind and polish lenses, it is too difficult. Ordinary paste will do.——ED MCGURK.

W. J. F.—It is my omission. Thanks. You say the contribution is not new. It has the merit of being a most interesting subject, and I think I have described it plainly, and made it simple enough as regards apparatus, &c.—ED. MCGURK.

RULE BRITANNIA.—Purchase them in Manchester of any respectable optician; it will be your cheapest plan.—ED. MCGURK.

SCREW THREADS.—One in a Fix will find that double threaded or any number of threaded worms can easily be made in the following manner. Take a piece of paper and draw a succession of straight parallel lines (the distance of the lines from each other depends upon the coarseness of the thread), then fold your paper round a cylinder (any size) instead of letting the top line meet the top line again. After passing round the cylinder, let it meet the second line, and it will have a single thread; place it to the third line and you will obtain a double thread. So you may increase the number of threads to any amount by cutting down each line after folded.



MAISIN JOHN FURZE.

STEAM POWER.—I consider that F. H. Y.'s letter involves a complicated question, the power of the engine not being in the engine itself, but in the amount of water evoporated into steam by his boiler. Now, it stands to reason that if a certain amount of water will produce a given amount of power, that twice that amount of water will produce double the amount of power if subjected to the same influence under the same circumstance. According to Watt, one horse-power was equivalent to a cubic foot of water converted into steam in one hour. Taking it then that his boiler converts into steam five cubic feet of water in the hour, he will understand that his power, plus the amount necessary to overcome the friction is equivalent to the power exerted by his smaller engine, and that twice that amount of power under the same circumstances, plus the allowance for friction, will equal the power of his larger engine. From this he will understand that, the engine not being the power, but merely the machine by which the power is applied, as long as that machine is of such dimensions so as to be capable of employing that power which I take his engine to be, the fault cannot lay with itself. He must, therefore refer to the boiler for the solution of this mystery. If his boiler is designed to supply a given power less than a 10 horse-power, we will say 5-horse-power, it will have its heating surface proportioned to evaporate a given amount of water, with so many pounds of coal, according to the ideas of the maker, and, as long as that amount of coal is properly supplied the smaller engine, &c., will work efficiently. F. H. Y. now takes away the smaller engine, and supplies the boiler with twice the amount of fuel. By theory, this should work well, because twice the amount of heat will evaporate twice the amount of water, but engineers know from experience that this will not be the case for, as the heating surface has not been increased, the time occupied by the air passing through the flues will not be sufficient for the water to extract the required quantity of heat; therefore the increased heat would not be fully used. This is but one of the many means, but it would take a long letter to describe them. Any explanation I will give with great pleasure. I should be glad if he would give his opinion, that I might judge it and I will accept with great pleasure the opinions of any others of your readers.

In a former number of this paper a correspondent proposed that a full-sized engraving of some mechanical contrivances designed by the subscribers of this paper should be published along with it now and then. As you seemed inclined to accept this proposition, I now propose that when you consider it necessary to issue one of these engravings, that you insert a paragraph at the top of the column devoted to "Answers and Notices to Correspondents and Readers" to that effect, that myself and others of your readers may have time to prepare our drawings, &c. As these drawings may not be intelligible to all, I propose that they should be neatly lettered, and accompanied with an article explaining their capabilities. If this should meet with your approbation, I hope that the requirements of this portion of my letter will be swiftly answered. Will Mr. Martin be so kind as to oblige me with a more lucid explanation of his lathe centre?—ADRIAN NEISON.

ANSWER TO LEARNER.—The diagram explains, we shou'd have presumed, clearly what the author meant, without even the description given. We will however, endeavour to further assist you. The travel mentioned 6 inches is an assumption for the purpose of explaining the problem thus:—

a = Travel.
B = Width of port
x = Lap of valve or the unknown quantity.

Then $\frac{a}{B \times 2}$ $\frac{4 \text{ inches}}{2}$ = x or 2 inches.

When the author states that the half travel of the valve = width of opening or port, plus outside lap, he merely reiserates the meaning of the five illustrations in pages 43, 43, and 45.

POWER OF MICROSCOPE.—A microscope is advertized as magnifying perhaps 4 or 6,000 times. I bought one said to do this, a compound one with four object pieces, but a piece of moth's wing 1-10th of a square inch does not appear to be so very much larger after all certainly not 6,000 times, or even 6. How is the term of the magnifying power to be explained?

PHOTOGRAPHIC.—A. P. may remedy his both defects by bottling it, making it slightly alkaline by the addition of ammonia, and placing it in sunlight until the organic impurities are precipitated, and the solution appears bright and clear. A thirty grain nitrate bath iodised with four grains of iodide of potassium to the sixteen ounces newly made gave the celebrated Mr. Wilson some of his best instantaneous pictures. In winter the silver bath should be stronger, say 40 grains. A. P. must be particular to use pure distilled water in making his bath for this purpose.—R. H. P.

PATENT COMPASS.—Your correspondent R. W. Willis has got on the wrong tack altogether. My patent compass is not an insulator, just because it cannot be done. The compass needle may be counteracted by opposite poles, and by such means it may be rendered perfectly astatic, but insulation is out of the question. The principle I have adopted in my patent is counteracting and adjusting. I place my several counteracting magnets in such a position on the compass card, that the needle may have a portion of free polarity just sufficient for its working and no more; but there is no insulation. I keep up my currents by other adjusting magnets placed also on the card for that purpose.—ROBERT ALEXANDER.

SKIN PRESERVING.—YOUTH.—Small skins may be preserved in the following manner. They are first cleaned and scraped; they are then rubbed over with arsenical soap, prepared thus:—To four pounds of white curd soap add one pound of arsenic and one ounce of camphor; cut the soap into thin slices, and dissolve it in one pint of water. When melted, add the arsenic and camphor, stirring them well together, and boil again, until the substance of a thick paste is attained, and pour it into jars while hot. When cold, tie it up carefully with bladder, and it will retain its qualities for years.

POLISHING SKELETONS, &c.—My general way is to place the skeleton near an ant's nest. In a week or so the flesh is all eaten off, and the bone is polished superior to any work of hand. Horns might probably be polished in the same manner by rubbing over them some fatty substance that the ants will eat.—T. ALLEN.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

36. John Moore, Henry Moore, and George Lund, Burnley, improvements in looms for weaving. Dated January 5, 1866.
37. John Jackson, Sudden Brow, Rochdale, improvements in mills for grinding corn and other grain. Dated January 5, 1866.
38. William John Symons, 131, St. James'-road, Holloway, improvements in smiths' forges and furnaces for smelting and puddling iron, steel, and other metals. Dated January 5, 1866.
39. James Ronald, Liverpool, improvements in or applicable to machinery for combing, dressing, and disintricating hemp, flax, wool, cotton, and other fibres and fibrous materials. Dated January 5, 1866.
40. Elias Taylor, Hartford Villa, Patcham, making building bricks impervious to water or waterproof. Dated January 5, 1866.
41. John Francis Wheeler, Ryde, Isle of Wight, an improved apparatus for warming feet. Dated January 5, 1866.
42. Edmund Walker, London-street, improvements in windlasses. Dated January 5, 1866.
43. Henry Duncan Preston Cunningham, Bury, improvements in working and in the service of guns with fittings thereof, and in gun carriages. Dated January 5, 1866.
44. William Winter, Leeds, improvements in locomotive, stationary, and marine engines. Dated January 5, 1866.
45. Alfred Vincent Newton, 66, Chancery-lane, improved apparatus for feeding steam boilers. Dated January 5, 1866.
46. Horatio Ames, Morley's Hotel, Charing-cross, improvements in ordnance. Dated January 6, 1866.
47. William Clark, 53, Chancery-lane, improvements in bridges. Dated January 6, 1866.
48. Frederick Tolhausen, 149, Boulevart Magenta, Paris, improvements in locks. Dated January 6, 1866.
49. William George Beattie, Southbank, Surbiton, Surrey, an improved apparatus for lubricating purposes. Dated January 6, 1866.
50. Baron Oscar de Mesnil, Brussels, improvements in towing boats on rivers or canals, a part of which is also applicable to the traction of vehicles on rail or tramways or common roads. Dated January 6, 1866.
51. Henry Haley Collins, 58, London Wall, improvements in printing presses known as copper-plate presses. Dated January 6, 1866.
52. Thomas Sagar, machine maker, George Keighley, machine maker, Joseph Clegg, weaver, and Thomas Richmond, manufacturer, all of Burnley, Lancaster, certain improvements in looms for weaving. Dated January 8, 1866.
53. Timothy Joseph Clanchy, Cathedral Club, Cathedral Hotel, Manchester, an improvement in collars for the neck. Dated January 8, 1866.
54. Thomas Welcome Roys, 44, Castle-street, Liverpool, improvements applicable to the hoisting or lifting tackle for recovering sunken whales or other submerged bodies. Dated January 8, 1866.
55. James Kerridge and William Peverett, Leiston Works, near Saxmundham, improved machinery for assorting grain and seeds. Dated January 8, 1866.
56. Archibald Gibb, Maryhill, Lanark, improvements in machinery or apparatus for the construction or making of moulds for casting in metals. Dated January 8, 1866.
57. James Hodges, Penny Hill, Bagshot, Surrey, improvements in machinery used for raising and treating peat or bog earth or soil. Dated January 8, 1866.
58. Herbert Newton Penrice, Witton House, Norwich, improvements in machinery employed in forming tunnels and galleries in rocks. Dated January 8, 1866.

LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 6TH JANUARY, 1866.

290. Signalling in railway trains, E. Whittaker—4d.
357. Railway and other signals, A. W. Banks—4d.
366. Steam cultivator, R. Winder—8d.
367. Patched balls for fire-arms, M. Peck—8d.
368. Locks for fire arms—J. P. Linsay—1s.
369. Fastenings for doors, windows, &c, G. R. Meek, and W. H. Howes—4d.
370. Working sewing machines, A. V. Newton—1s. 10d.
371. White pigment, J. Dale,—4d.
372. Breech-loading ordnance, A. Krupp—1s. 6d.
373. Scissors, shears, and edge tools, C. Lingard—4d.
374. Blast furnaces and cupolas, E. Leigh—1s. 4d.
375. Rolling and hammering iron, J. Ramsbottom—8d.
376. Preparing cotton and other fibrous substances, E. Lord—10d.
377. Looms, R. G. Hazard—4d.
378. Signalling in railway trains, A. C. Edwards—4d.
379. Affixing adhesive labels, H. W. Hart—6d.
381. Boots and shoes, G. Coles, J. A. Jaques, and J. A. Fanshawe—8d.
382. Boxing, fencing, and cricket gloves, H. Emanuel—8d.
383. Counting coins, money, &c., J. Schuenhr—4d.
384. Reaping and mowing machines, D. H Barber—10d.
385. Brooches and lockets, G. C. Haseler, and J. B. Hasler—6d.
386. Railways, J. and J. Porter—8d.
387. Buoys, beacons, floats, and pontoons, C. Atherton, and A. H. Renton—8d.
388. Machinery oils, J. Hall—4d.
389. Winder for ribbons, &c., T. A., and M. A. Verkruzen—8d.
390. Heating water and connecting metal pipes, A. McLaren—4d.
391. Separating gold and silver from their ores, W. Crookes—4d.
392. Alarums, C. West—4d.
393. Case hardening iron, E. H. Newby—4d.
394. Pen and pencil holder, E. J. Hill—6d.
395. Furnaces, boilers, and apparatus for regulating the flow of steam J. Cass—3s. 4d.
396. Sewing machines, A. V. Newton—1s. 4d.
397. Cupolas and blast furnaces, H. H. Grierson, and J. M. Rigby—4d.
398. Caoutchouc, P. A. Le Comte de Fontaine Moreau—4d.
399. Cutting and marking collars, &c., D. Burr, W. H. Page, and J. C. Newey—1s. 4d.
400. Rivetting machinery, H. M. Kennard—4d.
401. Steam boilers, R. W. Thompson—8d.
402. Gunpowder, L. H. G. Ehrhardt—4d.
403. Extracting turpentine and tar from wood, J. A. Pastorelly—8d.
404. Bogie frames for locomotives and carriages, W. Adams—1s. 4d.
405. Paddle wheels, J. G. Tongue—10d.
406. Penholders, F. C. Vannet—6d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

SIMPLE METHOD OF PREVENTING BOILER INCRUSTATIONS.—In a manufactory at Lorenzehacht they use water holding a little clay in suspension, and after three months' work find on the sides of the boiler only a little mud, which is easily scraped off. This mud is nothing more than the clay itself, which prevents the deposit of crust mechanically by keeping the particles of deposited matters apart.

THE MARKETS REVIEW.

REMARKS

The Metal Market during the past week has not shown any great degree of animation; but it is usually the case at this period of the year that comparatively little business is doing. Although not greatly influenced by the fluctuations in the money market, yet to a certain extent it is affected by the high rate of interest. This is felt especially in speculative business, which cannot fail to be acted upon by tightness in the money market; and we must, therefore, expect to find that these kinds of transactions are less frequent than they were a short time since. Altogether the general appearance of the metal market is by no means unfavourable, and we look forward with confidence to much activity in metals during the year.

COPPER.—The market for this metal is in rather an uncertain state; some parties maintaining that prices will again go up and that we shall yet see copper both dear and scarce; while others consider that the affair beeween Spain and Chili will be settled ere long, and that then prices will become lower.

IRON.—In Staffordshire there are not many orders to hand, but there is every prospect of a good demand. There are some fears lest the United States Congress should again rise the duties on the importation of iron, otherwise a large demand from America seems certain. In Welsh, as the preliminary meeting of the ironmasters recommended no alteration in current rates, buyers have given out orders more freely, but it is not expected that any extensive transactions will take place

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before the usual quarterly meetings are held. The exports are about an average, which at this season of the year is satisfactory.

LEAD.—The market is firm.

TIN.—English remains steady at the official rates, but the market for foreign has become very flat.

Spelter has not been very active during the week

Tin-plates continue very active, and an advance of 1s. per box has been announced by some makers.

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	102	0	0	106	0	0
Best Selected	do	104	0	0	109	0	0
Sheet	do	106	0	0	111	0	0
Bottoms	do	113	0	0	116	0	0
Australian	do	107	0	0	110	0	0
Yellow metal	per lb.	0	0	9	0	0	10
IRON.							
Pig in Scotland	per ton.	3	6	6 cash.			
Welsh Bars, in London	do	7	15	0	8	0	0
Wales	do	7	0	0	7	5	0
Staffordshire	do	8	15	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
Nail Rods	do	8	15	0		—	
LEAD.							
Pig, Foreign	per ton	20	12	6	21	0	0
Sheet, milled	do	22	5	0	22	10	0
Shot, patent	do	24	5	0		—	
Red or minium	do	22	10	0		—	
White, dry	do	29	5	0		—	
„ ground in oil	do	28	0	0	29	0	0
Litharge (W.B)	do	24	15	0	25	0	0
Quicksilver	per bottle	7	18	6	8	0	0
Spelter, Silesian	per ton	23	0	0	23	10	0
English sheet	do	28	0	0		—	
White zinc, powder	do		—			—	
STEEL							
Swedish faggot	per ton	16	0	0		—	
„ Kegs	do	15	0	0		—	
TIN.							
Banca	per cwt	96	0	0	97	0	0
Straits, fine, cash	do	90	0	0	90	10	0
English Block	per ton	102	0	0		—	
„ Bars	do	103	0	0		—	
„ Refined	do	105	0	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.		£	s.	£	s.
Teak	12	10	13	10	2nd do	11	0	12	10
Quebec, red pn.	3	10	4	15	St. Petersburg yel.	11	10	13	0
yellow pine	3	10	4	0	Finland	8	10	10	10
Memel	0	0	0	0	Memel	10	0	15	0
elm	3	10	5	0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Dantzic oak	3	10	6	10	Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	6
fir	2	15	4	0	Staves, per tand-ard M.				
Memel fir	3	15	4	0	Quebec, pipe	60	0	65	0
Riga	3	10	3	15	puncheon	18	0	20	0
Swedish	2	10	2	15	Baltic crown pipe	220	0	250	0
Masts, Quebec, rd. pine	5	10	6	10					
yellow pine	5	10	6	10					
red pine	0	0	0	0					
Lathwood, Dant. fin	7	10	8	10					
St. Peter's	8	10	9	10					
Yellow Pine, per reduced C.									
Canada, 1st qual.	17	0	18	10					

MISCELLANEOUS.

	£	s.	£	s.		£	s.	£	s.
PUMICE STONE pr tun	5	0	8	0	Olive, Gallipoli	53	0	0	0
OILS, &c.					Cocoanut, Coch. ton	52	0	0	0
Seal, pale pr. tun	50	0	0	0	Palm, fine	44	10	45	0
Sperm body	115	0	117	0	Linseed	38	0	38	5
Cod	53	0	0	0	Rapeseed, Eng. pale	56	0	57	0
Whale, Sth Sea pale	48	0	50	0	Cotton, seed	35	0	42	10

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12 "	16 "
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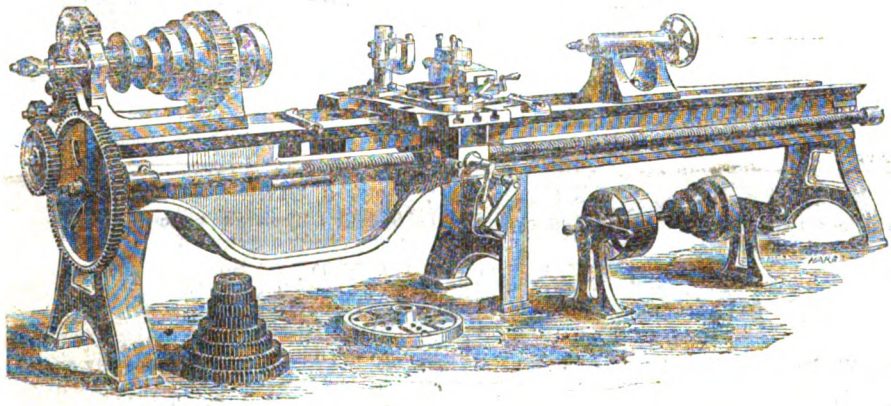

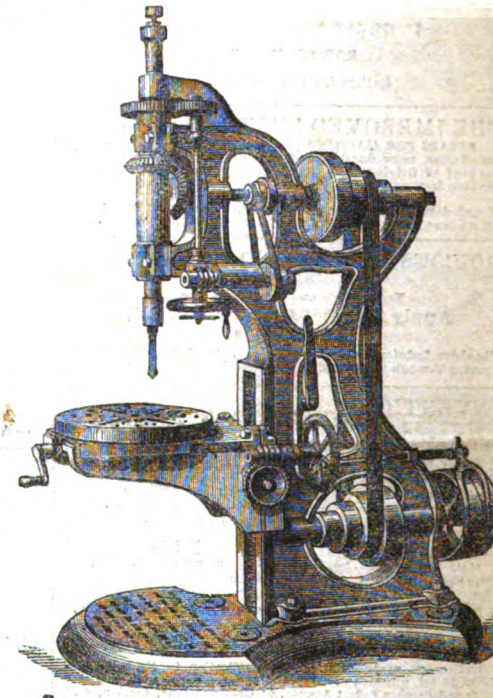

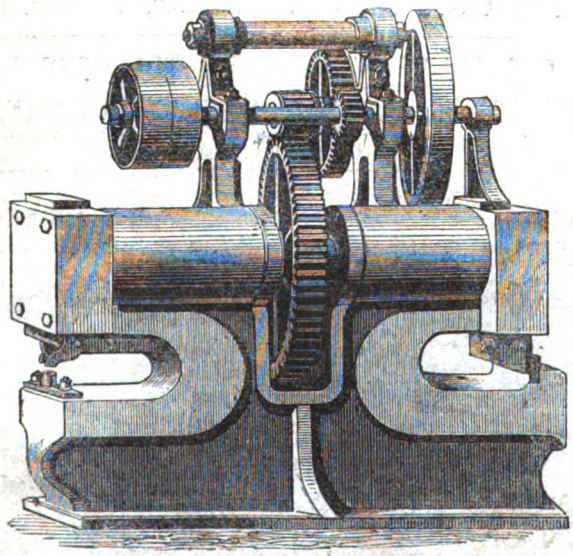

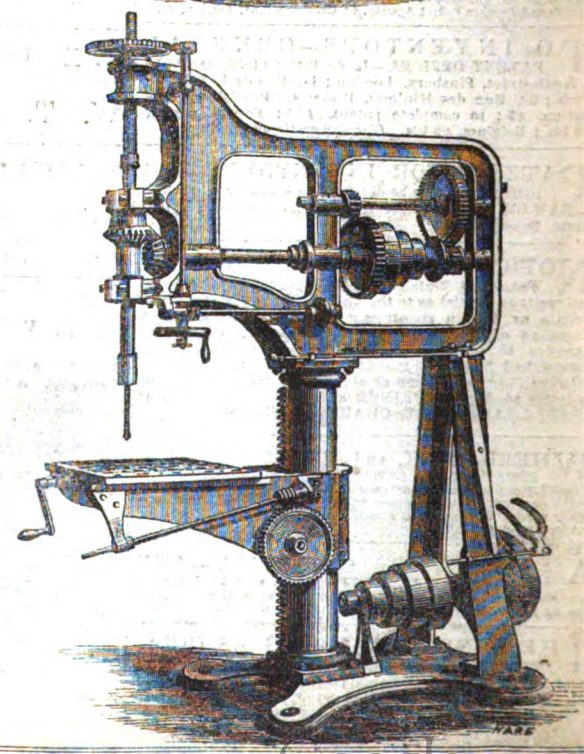

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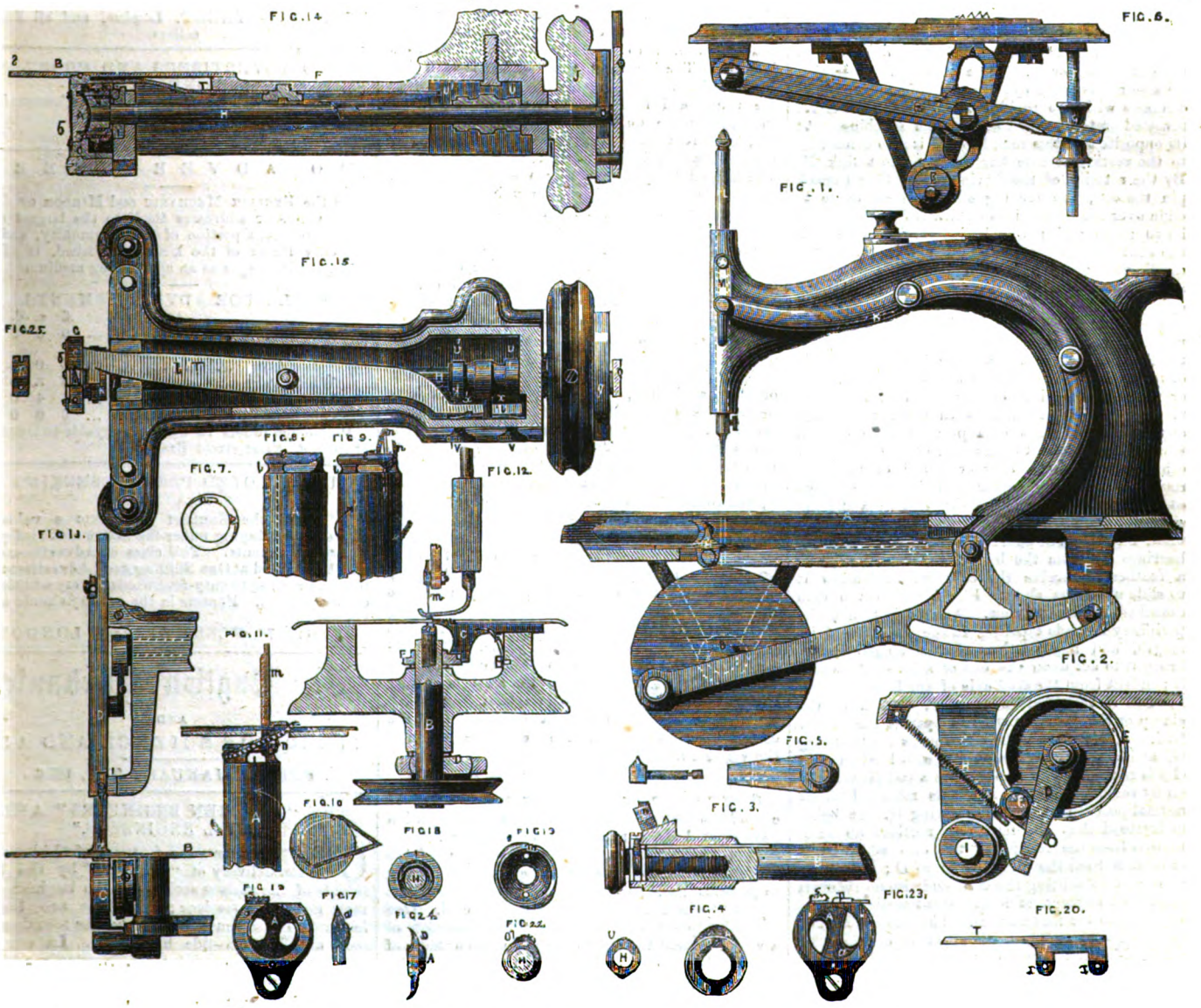
ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

A JOURNAL DEVOTED TO THE INTERESTS OF ALL CONNECTED WITH ENGINEERING, BUILDING, NEW INVENTIONS, MANUFACTURES, METALS, PHOTOGRAPHY, CHEMISTRY, TELEGRAPHY, ASTRONOMY, ELECTRICITY, &c.

VOL. II.—No. 44.] FRIDAY, JANUARY 26, 1866. [PRICE TWOPENCE.



ELIAS HOWE'S IMPROVEMENTS IN SEWING MACHINERY.

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SEWING MACHINERY.

I.

THE immense competition existing in the manufacture of sewing machinery compels inventors and manufacturers to study improvements in every particular: they are equal to the emergency, and no week passes in which there are not registered applications for letters patent, from all parts of the world, but more especially from America. The improvements we have this week to notice are by Elias Howe, jun., of New York, for which letters patent have been obtained here by Mr. A. V. Newton, of Chancery-lane. The first set of improvements relate to certain arrangements of mechanism for working the actuating parts of sewing machines—the first of which consists in an arrangement whereby the mechanism for transmitting motion to the needle and shuttle is simplified and a silent motion obtained. In side elevation Fig. 1 shows the shuttle about to commence its back traverse, and the needle descending to pierce the cloth to be sewn.

Underneath the front end of the bed A of the machine is a transverse shaft B mounted in bracket bearings; to this shaft a driving pulley C is keyed, having on its face a crank pin, to which a rocking slide D is attached, having at its rear end a curved slot by which it is suspended on a block piece E, carried by a stud pin projecting from a pendent bracket F below the bed of the machine, and which block piece serves as a fulcrum for the rocking slide. This slide D has a lateral projection D^1 at right angles to its length, which carries a stud, and by means of this stud it is connected to a rod G jointed at its other end to the shuttle driver H. The stud on the projection D^1 also receives the eye of a coupling rod I, which connects with the rocking slide a rock lever K, pivotted on the bracket arm of the machine. At its opposite end this rock lever K is also connected to the vertical needle bar L by a short link M. By the rotation of the driving pulley C and crank pin thereon, the rocking slide will be made to slide over the block piece (which is free to rock on its supporting pin), and by its connection with it the shuttle driver and needle-bar will operate the needle and shuttle, and timing their movements accurately to the requirements of the sewing operation.

The second head of this invention relates to means of obtaining the feed in sewing machines—the first improvement in which relates to the mode of regulating the length of stitch where the rotary or the wheel feed is employed. Fig. 2 is a side view of the rotary feed, with the improvement applied. It consists of a peculiar form of cam which gives motion to the reciprocating clamps or other drivers of the ring or wheel carrying the roughened or feed surface. This cam is shown at A; it is mounted on the end of a driving shaft B, as shown best in the detached sectional view, Fig. 3. The shaft B is carried in bracket bearings C from the bed of the machine, with a feather to receive the cam A, and allow it to slide upon the shaft. Fig. 4 shows the cam detached and in end view. The projection on its periphery is made tapering in the direction of its length, and any portion of that length can be brought to act upon the end of a lever D, which is pendent from the stud axle of the feeding wheel E, and is intended to transmit motion to the clamp or other driver used to operate the rotary feed. A clip F is shown which grips the feed ring G, and causes it to turn on its wheel when that clip is rocked. The clip carries a tail piece acted on by rocking lever D, and it is returned to its normal position by a tension spring H. It being understood that the feed ring receives an axial motion from the rocking of the clip which is set in motion from the pendent lever D; it will be seen that by shifting the cam endwise on its shaft any desired extent of intermittent motion may be imparted to the feed surface. The endway adjustment of the cam on its shaft is obtained by a milled-headed screw I, screwed into the end of driving shaft B. In a shoulder at its outer end a circular groove *b* is cut to receive a pin *d* from he cam. The lowest part of the conical projection iving the least movement to the operating lever, represents the shortest stitch obtainable, and as the cam is slidden to and fro on its shaft, any desired amount of motion may be given to the lever to ensure the required length of stitch. The end of this lever D having a constant bearing on the cam, the clicking and hammering sound is avoided. It will be found preferable to fit it at its end with a bearing point capable of a slight turning action, in order that it may conform to the varying positions of the tapering cam. This arrangement is best shown at Fig. 5, where a bearing point *d* is shown detached from its lever D, but capable of being fitted thereto by means of a socket pin.

The second improvement under this head of the invention relates to a novel arrangement of reciprocating feed. This is shown in side elevation at Fig. 6. A is a slotted bar placed in a nearly vertical position beneath the bed of the machine, and terminating at its upper end in a curved head which plays through a slot in the throat plate as usual, and carries a roughened surface for taking hold of the cloth. The lower end of this feed bar terminates in a ring which embraces an eccentric B, mounted on a rotating shaft C, set at right angles to the line of feed. A straight longitudinal slot is cut in the feed bar to receive a swivel sliding block D, which is carried by a stud axle from a lever E, hinged to under side of table. The slot's direction is such that a line drawn through its centre would cross at an acute angle a line drawn longitudinally through the centre of the feed bar. The feed bar, by reason of its being mounted on an eccentric, is free to slide up and down, and to oscillate on this block as a fulcrum. The length of the feed bar is such that during about half a revolution of the eccentric the roughened feed surface is above the level of the throat plate, on which the material to be sown lies, and it thus presses upon the underside of the cloth which is held down by the foot presser. The hinged lever E carrying the sliding block or fulcrum D has a slotted end, through which passes a screwed rod F pendent from the table, to which rod are fitted two milled screw nuts G, by which the position of the hinged lever E carrying the sliding block is adjusted. By screwing these nuts up or down on the rod the fulcrum stud can be moved from or near to the eccentric, and the relative lengths of the parts of the feed bar above and below the fulcrum will be thereby changed, consequently the head which forms the feeding surface will, by reason of this adjustment, be moved less or more, as desired, in the direction the cloth is to be fed without any change in the movement of the eccentric. The obliquity of the slot in the feed bar is such that the tendency of the eccentric to rock the feed bar is counteracted by the opposite inclination of the slot, and the feed bar is caused by the rotation of the eccentric to rise practically perpendicularly to take a firm hold of the material to be sewn; when this action becomes subsidiary to the oscillating movement given to the feed bar by rotation of the eccentric through the upper quarter of its revolution, the inclination of the slot causing the forward movement of the feeding surface to be greater than that which would result from the action of the eccentric alone. The completion of the revolution of the eccentric will withdraw the feed bar clear of the cloth, and rock the feed bar back to its normal position, from which it will again rise to take a fresh hold of the material to be moved forward under the action of the vertical needle.

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THE ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART.

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No. 43, January 19:—Blampoil's Smoke Consuming Furnace, illustrated.—The Working Man and the Water Supply.—Practical Photography, illustrated.—Machine for Cleaning Brass Turnings, illustrated.—The Lathe and its Uses, illustrated.—Apparatus for Burning Petroleum, illustrated.—Drill Chuck, illustrated.—New Tool, illustrated.—Lathe Motion, illustrated.—Polarising Glass, illustrated.—Amateur's Gas Blow Pipe, illustrated, and many original and selected articles of value, alike to the amateur in the Arts and Sciences, and the practical mechanic. Back numbers always in print.

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AND

MIRROR OF SCIENCE AND ART.

FRIDAY, JANUARY 26TH, 1866.

THE "FOREMEN ENGINEERS" AND "CIVIL ENGINEERS."

ONE of the interesting features of this season is the delivery of "addresses" by the Presidents of the various societies at the beginning of their respective sessions; and these are looked forward to with much interest by the members so soon as Christmas-tide has turned. In our last number we made room for Mr. Newton's address to the Society of Foremen Engineers, and a very admirable one it was; though, of course, we had not room for all. Still in that which we gave there is much that is very interesting—especially

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that portion where the president, glancing back at the graves of men of genius, spoke earnestly of their fame and of the works left behind them, which will keep their memory green for generations. We go as far as Mr. Newton—even further, and trust that the tribute he paid so eloquently and "heartily" will be inscribed on the minutes or recorded at full length in the written transactions of the Society for the perusal of the Foremen Engineers of the future. A chequered life is that of nearly every member of that society, and so also is that of any man of note in the profession, be he whom he may. Many of them we know well, who take a pleasure in recording their various attempts at scaling Fortune's ladder, now that they have by strength of will become rich and famed for their rare talents. The indomitable courage and perseverance of such men must command the respect and admiration of all who know them. As Professor Goldwin Smith says, the great fact of life is death; but he it is whose loss is felt the most who makes the deepest mark on the society of his time. Mechanical and civil engineers, in the main, have made this country what it is—and their triumphs will stand out with a halo round them when the trumpet is hung in the hall, and war is no more studied. We have bridged over the span of centuries to the time of Cheops, rival Alexander and the Cæsars, have in fact left the great works of olden time behind us now, and are striving on in a grander race—grander because the good of mankind is the goal.

Yet we may not rest by the way. Good men fall therein exhausted, cheering on their fellows to deeds of greater daring; and that which has been finished in the year just closed, and is projected to be carried out in the years to come, shows that the example set by those who have dropped dead in their harness has not been set in vain. We repeat the words of Mr. Newton to his fellow labourers, to go onward—to work, work. Not to talk and vapour about what has been done, but to scheme out what is new, and, if possible, better; for true mechanical genius, as with aught else of greatness, knows no jealously. It is a piece of great good fortune for the society that they have Mr. Newton as President. He is a credit to them and to himself. Any society might be proud of him as their president; and we know that the society has in him a faithful servitor, whose heart is in his work, and who knows not what it is to be tired in doing what is for the good of the foremen engineers. To be worthy of such a president is to do his behests, and raise the status of the society higher than it now is, by descriptive and speculative papers, and discussions. In doing this a triple benefit accrues, the society is benefitted, the member becomes a sharper and shrewder man, and his employer gets more value for his money. And we might add that, in the end, society at large receives the principal share of good. True happiness, it has been well argued, consists in performing one's uses faithfully. This statement will bear dissection down to the last joint in its vertebra, for it is perfectly true. Were this better understood, we should have less of that villanous competition which is sapping away at the foundations of society, but which we confidently predict it will not succeed in overthrowing so long as there "are out and about" such workers as the men whose designations head this paper.

Taking a different line, Mr. Fowler, as President of the Institute of Civil Engineers, descanted at great length, and in excellent manner, on what the civil engineer should be, on what goes to make up such an individual—especially if he desires to make his mark on his time. What is required of the civil engineer is something prodigious—but after all, it is not more than that which the mechanical engineer must master to be anything greatly exceeding a plodder. We wish it were in our power to give room to Mr. Fowler's speech; the will must be taken for the deed.

So long as the two branches go on as they are doing, we will have nothing to regret save the loss of those who are called away year by year; we dare predict for the years to come greater triumphs than have been achieved in the buried years, and trust that we will often have to notice in connection with the men who shall achieve those triumphs the names of John Fowler and Joseph Newton.

ACCIDENTS IN MINES.

II.

MINING work is so exceptional and so much at variance with all that constitutes healthy and agreeable occupation, that those who devote themselves to it should be provided with every means for making it at least safe. It becomes the duty then of scientific and practical men who follow employments, which, however arduous and difficult, are free from physical danger, to take thought for their fellows who are never out of it. The first necessity of life above ground is undoubtedly an abundant supply of fresh air, and this, as a general rule, is easily obtainable. For life below ground, the same want exists, but it cannot be supplied except by mechanical means. Nature is always accommodating and kind, and in her great laboratory operations and processes, visible and invisible, are continually going on, all of which are manifestly designed to sustain the great human family in health and comfort. Natural laws, however, may be strained to their utmost limit, and are too often misunderstood and misapplied by man. Hence errors, and what are called accidents arise. It has been demonstrated over and over again, that in mines, artificial or forced ventilation, as a supplemental agency to that of the natural action of the atmosphere, is the one main requirement, and that without it, death may be said to lurk in every corner. The problem is, to remove, as rapidly as they are released from their prison house, the earth, the foul gases generated there, and to supply their place with air from above, having the due admixture of gases, which fit it for respiration. Manifold have been the plans resorted to for solving that problem, but to a very great extent it remains unsolved, and painfully is the poor miner often reminded of the fact. It is not our intention to enumerate the various modes resorted to in the collieries of this country for insuring ventilation. Some of them are primitive, some are ingenious, some complicated but ineffective, and none are perfect. In this direction, much, therefore, remains to be done, and much will, we trust, ere long be done.

The next point to consider is, how can we make the best of things as they are for the preservation of the miner's life and limbs? The safety lamps of Stephenson and Davy are the great protectors relied upon by mine owners and mine workmen, and they are undoubtedly of much service. They are based on the same principle, although the details of their construction differ, and each kind has its advocates and patrons. Both are infinitely superior to the old system of "naked candle" testing and lighting, and they have in their results, justified the title given them. *Safety* lamps are, nevertheless, not infallible. They are subject to disarrangement by accidents even while in fair use. They are positively *dangerous* lamps when tampered with in any way, as it is to be feared they too often are. The temptation to obtain more light than is emitted through their gauze coverings has no doubt led many a workman to the destruction of himself and fellows. More light means, in his estimation, more coal, and more money; piece-work being the order of the day in almost all mines, and hence the risk of death is incurred. The "Geordie" and the "Davy" reflect honour on their inventors, but something more is required before mining is relieved of its present terrors.

Fire-damp is the deadliest foe of the miner, and unfortunately it is subtle as it is deadly. Its slow accumulation is one of its most dangerous characteristics. The flame of the safety lamp becomes pale and elongated as the mass of fire damp around it intensifies, for it requires to be sustained by air of a certain degree of purity, as he does who works by its dim radiance. This should operate as a warning. Sometimes it does, at others it does not. In spite of the ghastly notice of his lamp, the miner works on until he is surrounded by a highly imflammable and explosive fluid which awaits only the contact with fire to display its terrible nature. The worker might then as well be working in a gunpowder magazine with steel instead of copper tips on his shoes. The danger is as imminent in the one case as the other, but it is hourly braved in our coal pits. It has been said that safety lamps indicate the varying per-centages of fire damp impregnating the air around them, by the changing hues and length of their flames. They may do so to the practised eye constantly watching the phenomena, but the workman has something else to do. Watching his safety lamp will not keep his own home lamp trimmed and burning—he must labour in order to do that. His wife and children must be fed at all events. That is the light in which he sees things, and he works on with a will regardless of merely chemical—we had almost said chimerical—warnings; he dies at his holy task, and another item is added to the list of deaths in the coal pit.

It is evident, then, that in the absence of good ventilation, other agents than safety lamps are needed. So far as they go they are useful auxiliaries—and that is all.

With a knowledge of these facts, and with a complete acquaintanceship with the natural and beautiful law of gas diffusion, Mr. Ansell, of H. M. Mint, has invented a Fire damp indicator which registers unfailingly the exact per-centage of fire damp surrounding it, and gives *audible* token of the presence of danger. A description of the various forms of the apparatus, and some comments upon the late fatal explosion in the Gethin coal pit, must form the subject of a third paper.

JOSEPH NEWTON.

OUR COAL SUPPLY.

THERE seems to be little doubt in the minds of many intelligent men at the present time that we can fix a limit to the duration of our coal supply—that valuable fossil on which so much, if not the best part, of the commercial prosperity of our country depends. Within the last few months carefully prepared statistics, founded on certain well-known facts, have been brought forward, which must fix public attention to the matter. Looking at these later statistics, we find that the limit of duration for our coal stock is 100 years. We are not alarmists, nor can Sir William Armstrong be so termed, and we think it but right at the present time to repeat his statement. He says, "The greatness of England much depends on the superiority of her coal, in cheapness and quality, over other nations; but we have already drawn from our choicest mines a far larger quantity of coal than has been raised in all the rest of the world. The time is not remote when we shall have to encounter the disadvantages of increased cost of working and diminished value of produce. Estimates have often been made of the time required to produce complete exhaustion of all the accessible coal in the British Islands. The discrepancies in these estimates arise, not from any substantial disagreement as to the available quantity of English coal still in existence, but from the difficulty of estimating the rate of consumption in the future. The statistics collected by Mr. Hunt, of the Mining Record Office, show that at the end of 1861 the quantity of coal raised in the United Kingdom had reached the enormous total of 86 millions of tons, and that the average annual increase in the eight preceding years amounted to 2¾ millions of tons. Assuming 4,000 feet as the greatest depth at which mining operations can be carried on, the entire quantity of available coal existing in these islands has been calculated to be about 80,000 millions of tons, which at the present rate of consumption would be exhausted in 930 years; but, with a continued yearly increase of 2¾ millions of tons, would only last 212 years." Thus Sir William; but as we said above, this period of duration has been reduced by one-half in later estimates. Here is food for reflection for every thinking mind. But—there is always a *but*—are we quite certain that the whole of our coal-fields have been explored? We think not. Our Ordnance Survey is not yet finished, a great deal remains to be learnt concerning Wales and Ireland; and it is

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not impossible that, owing to lack of trial, we know not more than two-thirds of what trial and inquiry could make known concerning English and Scotch coal-fields. For how comes it that every now and again a fresh field is found—or, at least, that the public prints inform us such has been found? Yet this may not prevent us urging the careful study of this truly national question. We must have coals, or an equivalent, and we must know more, by a long way, concerning our coals, than we now do. The matter should at once be made a specialty by the Government, and a small, workable, permanent commission appointed, which shall institute inquiries over the length and breadth of the land, making quarterly reports for the benefit of all. And the Ordnance Survey should be pushed forward to completion rapidly and carefully. How much we depend for our commercial existence on coal let every trade tell. It is sufficient to look at our immense iron and steam-shipping business—to glance at the immense consumption in towns—at our expanding railway system—and to think what would each and all of these be with a short supply of "home-grown" coal, or with a fluctuating one drawn from foreign sources. Looking at it in this light, and seeing how much we depend on the "raw article" for meat and drink, it will strike most folks as only just that a stir should at once be made in the matter, and everything done that can be done by the Government of a commercial country to get at the exact truth (if that ever can be got at) in the most rapid manner possible, expense being a secondary consideration. An Act would be required giving powers of entry on all lands, where it is desirable to pursue actual experiment, the same as is accorded to railway companies; though we should think landowners would be only too glad to give free entry on such an important errand.

It may not be out of place here to remark on the necessity existing for the establishment right throughout the country of geological societies. Such exist in many localities, and are great successes. Several of these societies have had drawn up excellent charts of their districts, on which is summed up the products of their explorations and tests. It would be well if these were published, for the benefit of all. And here we may remark on the great good to be achieved from the bestowal of Government scholarships on the most proficient students in these schools or societies—scholarships of such value as would enable the students to come up to our mining school, and live whilst they learnt. Be assured that something like all this will have to be done; and the sooner it is done the better for us as a nation. The question cannot be shirked. The "woes and wrongs of Ireland" are of far less importance, perhaps, at the present day than this is, and the more searchingly and perseveringly it is gone into now the better will it be for us all hereafter. Meanwhile those who are engaged in perfecting new motors, who are striving to utilize petroleum as a fuel, may persevere, sure of a fitting reward; for one thing at least is certain to rule in their favour, and that is, the price of coal. Steadily it is rising in value, and so will their inventions as they are brought out; and they will certainly experience the truth of the old adage, that "'Tis an ill wind blows nobody good."

OUR JOURNAL AND THE MECHANICS.

WE have received the following pleasing letter from Mr. John Cormell, of the Lowsdown Ironworks:—

To the Editor of the ENGLISH MECHANIC.

Sir,—I am sure you will be pleased to hear that mechanics here appreciate your journal.

On Friday last, my workmen had their annual supper, and amongst other toasts, "Long life and prosperity to the ENGLISH MECHANIC," was heartily drunk and responded to; feeling sure that your heart would be open like your columns to appreciate anything of the kind emanating from mechanics, I send it you. JOHN CORMELL.

Lowsdown Iron Works, Cheltenham,
January 15, 1866.

With a mixed feeling of pleasure and pride we make room for the above kind expression and appreciation. Most heartily do we return thanks, both for the toast and for the manner in which it was received. We may remark that there is no better way of promoting a good understanding between employer and employed than a right down good Old English supper. Further, we think our journal only requires to be known to be appreciated; we do the best we can to deserve success, and such gentlemen as Mr. Cormell materially assist us in securing it. We feel certain that large employers of mechanical skill will benefit by our journal being disseminated amongst their workmen, and in compliance with the suggestion made to us we shall be glad to forward a dozen copies, post free, to any employer for distribution. We only repeat what is conveyed to us fifty times a week in communications, that our journal has proved to thousands of mechanics of more value than would a large library, and at a cost which is not worth mentioning in the same page. We heartily wish success to every workman in the Lowsdown Ironworks, and to their employer.

PRACTICAL PHOTOGRAPHY.*

IV.

PURCHASE your chemicals at a photographic warehouse, or of a professional artist, if he will supply you, thereby securing the best materials. You need not lay in a large stock. Here is a list for your guidance.

Collodion, buy it uniodized, *i.e.*, the plain collodion and the iodizing solution in separate bottles. By mixing as you require some waste is saved, the cost per ounce is the same. There is much valuable information on collodion and photography in general to be found in the "Circle of the Sciences," vol. vii., "Practical Chemistry."

Protosulphate of iron	4	ounces.
Re crystallized nitrate of silver	2	"
Acetic acid	2	"
Alcohol	4	"
Citric acid	1	"
Pyrogallic do. sold in ½oz. bottles.		
Cyanide of potassium	1	"
Nitric and muriatic acids, each	1	"
Bi-chloride of mercury	½	"
Bottle of Sohnee spirit varnish.		

A small quantity of carbonate of soda and twopennyworth of blue litmus paper—this cut in strips and keep in a corked bottle. If you can procure a "Winchester quart" it will nicely hold your toning solution when you print. Most beginners like to be in a hurry, but remember the proverb "More haste less speed." If you have procured the chemicals, for which I advise you to pay ready money—you will not only be more careful, but avoid experiencing that disagreeable thrilling sensation which accompanies the perusal of a "long Christmas bill." First fix up your room, shut the door and examine well that no ray of daylight enters. Arrange your tables, &c., so that you can have the benefit of your coloured window when at work, and that when you open your door no bright light shall come flooding in. You may then proceed to filter the water, examine the bottles that they are perfectly sweet and clean, gum on blank labels, a strip of the albumenized printing paper wetted answers well, and graduate with the file and measure. This completed, you may proceed to mix your chemicals. Probably at this stage you will be prepared to rest, or to wind up for the day and do a little reading. I have not mentioned any handbook in particular, as there are so many, but I think the two following you will find very instructive, and make a good handbook when bound together:—"The Universal Text Book of Photography," by Harvey, Reynolds, and Fowler, of Briggate, Leeds, 1s.; and "The Principles and Practice of Photography," by Jabez Hughes, 379, Oxford-street, 1s. I may add, that as I have not the pleasure of knowing either of these parties, I merely advise you from the interest I have experienced in using them myself. I have also by my side the volume of the "Circle of the Sciences" I mentioned, and this year's volume of the "Popular Science Review." The two latter are more expensive. So much then for mental food. To resume, it is a good plan to draw out all the formulæ you require, and suspend it against the wall of your room for ready reference. When mixing or using your collodion, remember that it is highly inflammable—avoid a candle or lamp. Measure the fluid content of your earthenware bath with water, that you may form an idea of the quantity of solution required. Make at least twice the content of the bath. I need not go through the minutiæ of preparing your chemicals; filter them as you make them. Most formulæ run very much alike. The ones I generally use are the following:—

* Continued from page 211.

FORMULÆ.

GLASS CLEANER.
Tripoli, 2 drms.
Water, 2 ounces.
Nitric Acid, 1 drm.

COLLODION.
Plain, 3 parts.
Iodizing solution, 1 oz.

BATH.
Nitrate of silver, 40 grs. to the ounce of water.
Iodide potass, 4 grs. } add 1 drm. of this solution to each
Water, 1 oz. } ounce of the bath.
Neutralize—filter - 4 or 5 drops of Nitric Acid to 6 ounces of bath.

DEVELOPER.
Sulp. iron, 3 drms.
Acetic Acid, 1½ drms.
Alcohol "
Water, 6 ounces.

Silver solution for 1 and 2, 10 grs. to the ounce.

INTENSIFIERS.
No. 1. Iron.
Sulp. iron, ½ drm.
Citric Acid, 1 drm.
Water, 6 ounces.
No. 2.
Pyrogallic Acid, 10 grs.
Citric Acid, 20 grs.
Water, 30 ounces.

FIXING SOLUTIONS.
Cyanide potassium, 1 drm. } Hypo. soda, 4 ounces. Water, 10 "
Water, 6 ounces. } Dilute with one-sixth of water additional for fixing prints.

BRIGHTENING SOLUTION.
1st.
Bichlor: mercury, 2 drms } dissolve with gentle heat.
Hydro-chlor. Acid, 2½ " }
2nd. Then of the above solution, 2 drms.
Sulpht. iron 2 "
Alcohol 3 "
Water 6 ounces.

PRINTING.

EXCITING BATH.
60 grs. to the ounce.

RINSING SOLUTION.
Acetate soda, 1 ounce.
Water, 20 ounces.

FIXING.
Soda (before).

TONING BATH.
1.
Water, 15 ounces.
Gold solution, 2 ounces.

NEUTRALIZE.
2.
Acetate soda, 1 ounce.
Water, 20 ounces.
Add 1 to 2 in a continuous stream. Prepare a week before required. Shake frequently.

DRY PLATE.
1st.
Gelatine, 5 grains. } Tannin, 15 grs. to water 1 oz.
Distilled water, 1 ounce. }
Acet. Acid, 5 drops. }

An improvement on the usual iron developer is noted in the last number of the "Quarterly Science Review" which may be rendered thus:—

Nelson's Gelatine ..... 10 grains.
Beaufoy's Acetic Acid ..... 1 ounce.

Make your usual developer, omitting the plain Acet. Acid, but add to each ounce thereof instead 1 drm. of the gelatinized: the effect is said to be very superior.

ELECTRO-METALLURGY.*

I WILL suppose the trough made as directed. Procure two porous pots—6 or 7 inches high and 2 in diameter—place one in the centre of each cell, let them stand on a disc of wood to prevent their adhering to the pitch. Place a cylinder of copper of about 1½ inch diameter, 7 inches high, in each porous pot, and one of zinc in each cell outside the pot. A metal strap, copper is probably the best, joins the left hand terminal to the nearest zinc; another strap the copper to the next zinc, and a third strap, the second copper to the right hand terminal. The strap coupling the centre plates should pass over the screw of the centre terminal, and the nut of that terminal screw down upon it. You will thus have a very convenient form for varying power, that is, you can have one or two cells.

The precipitating trough is the next to be thought of. A stoneware pan, about 16 inches long, 10 broad, 5 deep, oval shaped and glazed white, can be purchased at most china shops, and this forms a very good trough for the purpose when cased in a wooden box. The object of the box is chiefly to

* Continued from page 212.

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fix the terminals to the white glaze, to enable you to see the action that is going on clearly without disturbing the articles.

A sketch of the battery, plates, straps, terminals, &c., shall be given, for the guidance of those who have never seen such things.

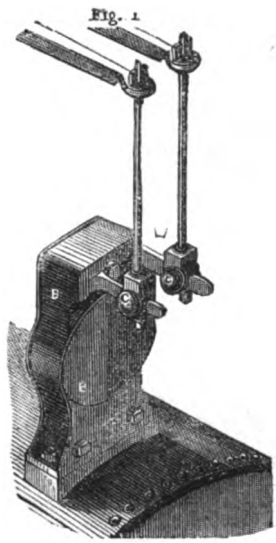
I may here state that the battery is known as Daniell's, or a modification of his principle, and is, I believe, the best one I could recommend, everything considered. The porous pot has been objected to, but I feel assured any student following my instructions will find little to complain of. However, if any should prefer a battery without I will point out one. It is, like many others, a modification of Daniell's, and was patented about 1851 by Mr. Fuller. I can recommend it from experience.

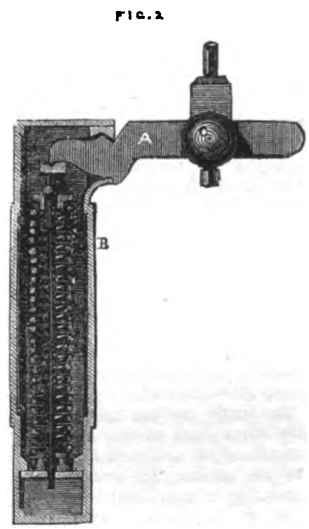
Construct the trough of inch or ¾ pine 9 inches by 9¼ external measurement, and 8 deep, and two partitions, in such a manner that each cell is 2 inches by 8 by 8 internal measurement. Now divide each cell again by a strip of plate glass or slate 8¼ long, 3¾ broad, by ⅛ or 3-16 thick, so as to form two small cells 8 inches long, 1 inch wide, and 3¼ deep. At the bottom of each cell previously named, I may mention that the partitions should be let into grooves. When complete thus far, set it upon a bottom slightly larger than its own measurement, for the same reason as given in a previous case, pitch it inside with as thin a coating as possible to leave it water tight, and fix four terminals on the partitions and ends. The copper plates should be 3¼ inches by 7½, and the zincs 4 inches by 7½. The copper to be laid lengthways in the small cell and sulphate of copper crystals in front of it. The bottom of the zinc plate hang on a level or slightly below the top of the copper and fill up with water, each cell to be done in same way. The peculiarity of this battery is not seen at first sight, so that an explanation may not be out of place. The specific gravity of the sulphate of copper, both as crystal and in solution, is greater than that of water, therefore mixes very slowly, when the battery is not in action, and again the copper plate is in a solution of its own material, and is not acted upon. The zinc at first is only in water, therefore may be said not to be acted upon; after some work has been done by the battery, sulphate of zinc is formed from the zinc plate, &c, and is dissolved in the water; but, from its gravity being less than sulphate of copper, it does not sink to the copper plate, and does not act upon the zinc; again the water is in proportion to the sulphate of copper solution as more than three to one, therefore crystals of sulphate of zinc can scarcely fall from careless management. The straps, which I have taken as understood, must be varnished with sealing wax, varnish, marine glue of solution of gutta percha, or they will be eaten away.

This battery has defects, as all that I know have, but I have used it for some 9 years and recommend it with confidence. MOMUS.

SAFETY-VALVE BALANCE.

THE improved safety-valve balance, illustrated by figs 1 and 2 of the annexed engravings, is the invention of Mr. William Camerer, of Reading, Pa., U.S. It was originally intended for locomotive engines, but can also be used on marine engines, or any place where a dead weight is objectionable. It is well known that a dead weight on a safety valve is the most desirable and safest wherever it can be applied; but on locomotive boilers which rest on springs it cannot be used, as its action on the valve would be influenced by the vibrations continually occurring. On marine boilers where weights are still in use, the rolling of the ship occasionally makes it necessary to lash the levers down until the weather moderates, thereby destroying the only virtue of the valve. Spring balances, as generally made, are more or less objectionable, on account of the springs becoming stiffer as the valve rises. Various plans have been adopted to overcome the defect by regulating the strength of the springs, thereby depending on the vigilance of the engineer to prevent the pressure from getting too great; whereas the balance here indicated requires no attention whatever when in use, as an increase over the allotted pressure cannot take place. The arms A A, can rise as much as the safety valve may require without additional pressure, which makes this balance equal in efficiency to a dead weight. The advantages of this improved balance are in the lever arrangement, by which the existing defects are remedied. The arms of the levers, A, inside the casting, B (fig. 1), from the fulcrum to the springs, are at an angle with the outside arms; and an upward movement of these outside arms is accompanied by a corresponding downward and also an inward movement of the inside arms resting on the springs; therefore the more the springs are compressed the shorter the effective length of the inside arms will be, thereby increasing the





power of the outside arms in the same proportion as the springs get stiffer from compression, thus enabling them to rise the required distance without increase of power. The rod, C, is fastened by a set screw to any distance from the fulcrum, according to the pressure required. Close behind this rod a small pin can be inserted through the arm to prevent the engineer from increasing the pressure beyond what the boiler was intended to carry, but as much of the arms as are not in the way of anything may be allowed to protrude for the purpose of decreasing the pressure, should any accident to the boiler make it desirable to do so. These balances have been in use more than a year on several of our leading railroads, where they give entire satisfaction.

REVIEW.

Harmonious Colouring, as Applied to Photographs. By an Artist Photographer. J. NEWMAN and Co., Soho-square, London.

It is well known amongst photographic portraitists that "coloured work," as it is called, has been decreasing in popularity for years, and that where many professional painters were formerly profitably engaged in painting photographic portraits we now find one or none. Various modes of accounting for this fact have been advanced, some of which give the blame to the painters, and others award it to the photographers. In the one case it is said that the painters, endeavouring to graft the conventionalities of the old miniaturists upon the excellences of the photograph, only succeeded in destroying the latter, and so lost public favour. In the other case it is affirmed that the vulgar taste and inartistic nature of the artizan photographer never allowed the painters fair play, and in others again that it is due to the introduction of *cartes de visite*. All these causes have probably combined to bring about the result we speak of. It is certain, however, that whereas photographers formerly employed educated artists at heavy salaries to colour their productions, they gradually introduced a new and considerably inferior class of labourers, ranking mid-way between the painter and the print colourist, and that as the new class of colourists grew up, public appreciation and patronage began to dwindle.

In the author of the excellent and practical little manual before us, we recognise a photographer who now holds a prominent position in regard to photographic literature. In parts of the work we have a little too much of the color-shop element perhaps, but on the whole the information it conveys is perfectly sound and reliable. The lists o colours given as necessary are truly formidable' and if every reader purchases such sets of pigments &c., as are here advocated, the publishers can well afford to sell this book at the remarkably low price at which it is published.

The well written introduction contains some invaluable hints, and we fully agree with the author when he says, "Unfortunately improvement in style has scarcely kept pace with prolificacy of production; and in matters pertaining to art, quantity is but a poor substitute for quality." He also adds of photography that "artists have felt much disposed to regard it as an illegitimate upstart, trenching upon their province, and claiming a large share of what art had hitherto regarded as its inalienable inheritance." There was a time perhaps when in some degree, and of a certain unimportant section of the class, this was true, but now-a-days the warmest admirers and best friends of photography will be found amongst artists, although they are of course not blind to those defects which all artistic photographers themselves regret the existence of. We wish we could say that photographers were as ready to learn from artists as artists are from photographers, for then should we find sun pictures far more truthful and beautiful than they are likely to be made by operations conducted as a mere branch of mechanical manufacture. We altogether dissent from the idea of this writer when he describes artists as "standing apart watching with sullen jealousy its progress," and "marking with secret satisfaction its deficiencies in some of the essentials of their art." An "*Artist* Photographer" should know better than thus to set class against class by making statements utterly at variance with published facts. Was not the first president of the first photographic society also the President of the Royal Academy? Were not its earliest meetings attended by a large number of well known artists, who took prominent positions in contributing to the interests and well being of the society? At the other photographic societies and in the photographic journals, artists have always played useful parts, although they have been coldly, and in many instances we could name insultingly received by photographers who were not competent to understand their suggestions, and were foolishly anxious to exclude

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(as dangerous to what they imagine to be "scientific progress"), every effort which did not pertain to processes and apparatus rather than to æsthetical improvements. Photography originated with artists, owes many of its most important discoveries to artists, and can only be elevated into the ranks of the fine arts by their aid; for a photographer therefore to persuade his brethren that artists are their enemies rather than their friends, must, of course, be both unwise, ungrateful, and ungenerous; and we are always sorry when in taking up a photographic journal, or attending a photographic meeting, we find the spirit we condemn assuming unfortunate dominance. In all other respects we can very warmly commend the work before us to the attention of our readers as a cheap, comprehensive, reliable, and artistic guide to the art of colouring photographs.

TECHNICAL CHEMISTRY.

New Processes for Covering Metals with an Adhering and Brilliant Coating of Other Metals. By M. FRED WEIL.

The author begins by observing that the galvanoplastic processes employed for depositing metals one on the other have the disadvantage of being expensive and requiring apparatus expensive to keep in repair, and which, as is usually the case with cyanurretted baths, are unhealthy for the workmen.

The process proposed and employed by M. Weil consists in the use of baths formed of metallic salts or oxides held in alkaline solution (sodic or potassic), and usually in presence of organic matters, such as tartaric acid, glycerine, albumen, or any other inoffensive substance which prevents the precipitation of the oxide by the fixed alkali. The deposit generally takes place at the ordinary temperature, but sometimes at a higher temperature. According to the author, his processes of the coppering and bronzing of iron, cast iron, and steel, are of special importance; he can, moreover, vary at will, the colours and tones, and produce a series of results which it has hitherto been found impossible to produce, either directly or in a durable manner.

COPPERING.

COMPOSITION OF THE COPPERING SOLUTION.—In ten litres of water dissolve:—

Crystallised sulphate of copper	350 grammes.
Crystallised sodic-potassic tartrate ...	1,600 "
Soda lime containing from 50 to 60 per cent. of free soda	800 "

This solution, which always gives very satisfactory results, contains nearly two equivalents of tartaric acid to one of oxide of copper.

ACTION OF VARIOUS METALS ON THIS SOLUTION—Iron, cast iron, and steel, as well as the metals, whose oxides are insoluble in potash and soda, undergo no change when introduced into these baths. For coppering, the zinc or lead is plunged into the bath, care being taken that the iron, cast iron, or steel articles should not touch each other, but that one of them should be in contact with the zinc. The copper was thus deposited upon, and strongly adhered to the iron.

The coating of copper increased within certain limits with the duration of the immersion. The author feels bound to admit that galvanic action alone will not effect the coppering of iron, cast iron, and steel, under the foregoing conditions.

In fact, the metals whose oxides are insoluble in potash or soda, and form only one basic oxide, become covered in the baths with but a pellicle of copper, the thickness of which does not increase with the length of time of immersion.

Pure tin introduced into the cold solution does not become coppered; by contact with zinc it oxidises; the protoxide of tin there formed reduces the copper solution, and protoxide of red copper is precipitated. The liquid holds no copper in solution after an excess of tin has been for some time immersed in it.

PROCESS FOR COPPERING. — The iron, cast iron, or steel articles are thoroughly cleansed by acidulated water; † they are then washed in plain water, and finally in water made alkaline with soda; then cleaned with a scracthbrush, again washed, and plunged into the copper bath in contact with zinc.

The articles are suspended in the copper bath by means of zinc wire; they should be immersed from three to seventy-two hours, according to the colour, quality, and thickness of the copper coating to be deposited. A tap is then turned in the lower part of the apparatus, the cuprous liquor drawn off, and the coppered articles washed in water. They are then taken out, cleaned with a scratchbrush, and dried, first in sawdust, then in a stove.

It is much more economical to use zinc wire than zinc plates.

To keep the bath of one strength while operating on a large scale, the author, by the advice of M. Dumas, arranges his apparatus in a particular way, so that the liquid is renewed from below, and flows away drop by drop, or in a fine stream from the upper part, the level being kept constant.

RENEWAL OF AN EXHAUSTED BATH. — After a great number of copperings the exhausted liquids are revived as follows:—

Precipitate the zinc in solution by sulphide of sodium, not in excess, and recharge the solution with sulphate of copper. The constant saturation of the coppering bath may be effected by the following means:—

Introduce into the reservoir containing the cuprous liquid a cylinder furnished at the upper part with an india rubber valve, opening upwards. The liquid should contain hydrated oxide of copper, and the plug be controlled by a sort of ballcock floating in the liquid of the reservoir. In proportion to the diminution of the density of the liquid from the effects of the coppering, the floating ball descends, and by so doing opens the plug. The liquid enters the cylinder and dissolves the oxide of copper; it should be shaken, and when the bath is restored to its normal density the valve will re-close.

The raw materials, of a certain value, which enter into the solutions of copper—that is to say, caustic soda, sodico-potassic tartrate or glycerine, serve thus for an indefinite time.

The advantages attributed by the author to his process, when all the precautions indicated are attended to, are:—

1. The perfect adherence of the copper deposited on iron, cast iron, and steel.
2. The rapidity, simplicity, and economy.
3. The faithful reproduction of the most delicate details.
4. The beauty of the colours.
5. The harmlessness and stability of the solution.
6. The power of repairing articles coppered or covered with any other metal by the author's processes. ‡

ORDINARY BRONZES.—Yellow bronzes bronze in beautiful tints in copper baths without contact with zinc.

The alloy which has been found to furnish the most beautiful tints by the action of cuprous baths was formed of—

Copper	83
Zinc	14
Lead	0·6
Tin	1·3
Nickel	1·1

BRONZING OF RED COPPER.—The bronzing of red copper, even when galvanic, is effected by contact with zinc by varying the nature of the salt of copper and the proportions of alkali and of sodico-potassic tartrate.

ZINCING.—Copper or coppered metals may be covered with zinc by immersion in a concentrated solution of potash or of soda heated to 100 deg. in presence of metallic zinc.

The coating of zinc deposited is fixed and brilliant.

The author considers the metal thus deposited to be less attackable by acid liquids than ordinary zinc.

TINNING AND LEADING. — Copper and coppered metals, as well as cast iron, iron, and steel, may be tinned and leaded in contact with zinc, by means of a salt of tin or lead dissolved in a strong solution of potash or caustic soda at 50 or 100 deg. Centigr.

A deposit of pure tin or lead is not obtained in this way, for it contains zinc. To produce a deposit of pure metal of increasing thickness, place in the vessel containing the solution of tin, a porous vase holding the alkaline lixivium and the metallic zinc. Plunge the article to be tinned into the outer vessel, and establish communication between the article and the zinc by means of a conducting wire. To revive the lixivium after it has become saturated with oxide of zinc, precipitate by sulphide of sodium.

TRUE BORNZING. — Iron, cast iron, steel and other metals may be covered with a coating of alloy of copper and tin (true bronze) by an operation effected without the aid of heat.

This result is produced by adding to the copper bath some stannate of soda, or a solution of bichloride of tin, previously treated with a sufficient quantity of soda; immersing the article in contact with zinc determines the deposition of bronze.

ALKALINE BATHS CONTAINING OTHER METALS INSTEAD OF COPPER.—Tarto-alkaline baths containing, for instance, cobalt or nickel, instead of copper, form no adhering metallic deposit in presence of zinc; they disengage hydrogen. Copper, or metals previously coppered, if heated, become covered with a white metallic deposit, consist of an alloy of zinc and cobalt, zinc and nickel, &c.

* Annales de Chemie et de Physique, iv., 374. Extracted from the "Chemical News," Jan. 5.

† The water acidulated with sulphuric acid to 2 deg. B. The action should be continued from five to twenty minutes.

‡ For this purpose clean the damaged part with an alkaline lixivium, surround the part with an elastic cup containing the solution, and touch the object with a zinc wire; a fresh deposit is then formed on the metal.

SOME EFFECTS OF THE ROTATION OF THE EARTH ON ITS AXIS.

In the *Comptes Rendus* (1861) is a very ingenious paper, by M. V. Raulin, "Sur les Différentes Revolutions de la Surface du Globe qui ont faconne le Relief de l'Ile de Crete;" but the author does not touch upon a fact that observation will yield in many localities. It first occurred to the writer when on the heights above the village of Upper Paoliana, Corfu. It is, that mountain ridges in a north and south direction are commonly more steep on the east than on the west slope. This is so much the case from Corfu, at the part named, through Cephalonia and on the east side of Zante, that it would seem to arise from some general cause. The same will be observed on the west coasts of Hindostan and South America. In North America a section of the Rocky Mountains presents the appearance of the edge of a saw, the steepest slopes being to the west. These elevations may be referred to the fifth tertiary elevation of M. Elie de Beaumont's system of Tenure, and their peculiar form may be ascribed to the motion of the earth projecting the west sides, adjoining the spots where the fractures occurred, to the greater height from which they did not return to their original positions, but remained as ridges with the steepest inclines to the west. This would have been more certainly the result had the disruption arisen from a sudden collapse or shrinking of the solid substance of the earth. Should this surmise be correct, a close examination of the other mountain ranges from which M. de Beaumont draws his deductions might show that the poles of the earth have varied in their sites, and that they were at one time nearly in the direction that we now know as east and west, which would explain the phenomena of a glacial period without a necessity for that hypothesis; *e. g.*, the existence of elephants in Siberia, Not having seen it stated anywhere, it may perhaps here be mentioned that the valley of the Conon, Ross-shire, exhibits traces of glacier action, the limestone rocks in many places bearing the appearance of *roches mountonees* with large blocks of stone scattered about in other parts that, from their position, must have been transported.

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WHITE PIGMENT.

Mr. J. Dale, of Manchester, has received Letters Patent for improvements in the production of substances to be used in place of the pigment termed satin white. The invention consists, firstly, in decomposing the material called satin white, containing sulphate of lime and alumina by chloride of barium or strontium, so as to replace or partially so the sulphate of lime by the sulphate of barium or strontium. Secondly, in the production of a material to be used in place of "satin white," by using caustic baryta or strontia instead of lime, as in the ordinary method of making satin white.

To carry the invention into practice:—When it is desired to replace the sulphate of lime in the ordinary satin white manufactured from lime and sulphate of alumina, diffuse the ordinary finished satin white through water, and add to it a solution of chloride of barium until the whole or part of the contained sulphate of lime is converted into sulphate of baryta. The proportions to be used may be varied according to the amount of sulphate of lime to be replaced. Five hundred weight of chloride of barium is sufficient for a ton of ordinary satin white. The supernatant chloride of calcium is removed by washing, and the resulting precipitate is pressed, and is then in a fit state for use. When it is desired to manufacture the satin white by the use of caustic baryta or strontia in the place of lime, take four equivalents of caustic baryta or strontia, and add it to one equivalent of potash or ammonia, alum or tersulphate of alumina. The mixture, "with moisture as in making satin white," is effected in a pug mill until the decomposition is complete, the product is then withdrawn from the mill, washed and pressed, and is ready for use. If a mixture should be desired to be made a certain amount of caustic baryta may be replaced by the addition of an equivalent quantity of caustic lime or strontia.

CASE-HARDENING IRON.

Provisional protection is sometimes refused to what those seeking it are pleased to term "an original invention." The matter we are about to give at length forms the subject of a "refusal," and was forwarded to this country from the States by "Anthony Leonard Fleury, residing at New York." Our readers are quite able to state what is "original" in the "Improvements in Case-hardening or converting partially into Steel Articles of Wrought or Malleable Iron," of Mr. Fleury. His provisional specification says:—The object of this invention is to carbonize and convert into steel portions of articles of wrought or malleable iron leaving other portions uncarbonized, and to this end a protecting coating or enamel composed of a mixture of oxide of iron with lime, lime alone, clay, silicate of soda or potassa, borax, the oxides of tin, lead, and antimony or other suitable protecting material is applied to those portions of such articles which are to be left uncarbonized, or in the condition of iron, the said articles are then placed in a close oven or furnace in which they are surrounded by heated carburetted hydrogen gas which acts upon their uncoated portions in such manner as to carbonize them wholly or to a suitable depth, and thereby convert the said portions alone, or the surfaces thereof into steel. This invention may be applied with great advantage to conversion into steel of the heads of wrought iron railroad bars of the faces of skate irons, the faces of malleable iron wheels, the surfaces of shafts and axles, and the edges of various articles of cutlery, and all articles of malleable iron may by this means be partially converted into steel. The oven furnace or chamber in which the carbonizing process is effected must be so constructed as to permit the exclusion of the atmosphere during the carbonizing process. The carburetted hydrogen gas may be generated in one or more retorts by the heat of the same fire which is employed to heat the said furnace, oven, or chamber, and the gas should preferably before its introduction into the carbonizing chamber be heated in a separate chamber or system of pipes acted on by the same fire. The articles which are to be partly carbonized or steeled may have the protecting coating or enamel applied to the parts which are not to be steeled in the form of a paste or liquid which will dry on the surface. To accelerate the process of conversion, other gases may be used together with the carburetted hydrogen, as, for instance, cyanogen and ammonia. The gases may be compressed with advantage, as by that means their action will be intensified.

THIN SHEET IRON.

We have on previous occasions reported the successive efforts of British and foreign ironmasters in the direction of producing sheets of iron of extreme tenuity. On the occasion of the meeting of the British Association, in September last, some large and very perfect sheets of iron foil were shown at the works of Messrs. Lloyds, Fosters, and Co., of Wednesbury, which weighed two grains per square inch; and we have already described the laminated metal produced by Mr. Parry, of Ebbw Vale, weighing only 1·5 grains per square inch. Since then great progress has been made by several manufacturers, and sheets of iron have been prepared of the marvellous degree of tenuity indicated by the measurement of 4,800 thicknesses being equivalent to one inch. They were produced in the mills of Messrs. W. Hallam and Co., Upper Forest Tinworks, near Swansea, and are in the form of perfect sheets, measuring 10 inches by 5½ inches, or 55 square inches, and weighing no more then 20 grains, or 0·36 grain per square inch. A noteworthy circumstance in connection with these thin sheets of iron is their remarkable degree of permanence, or power of resisting the oxidising action of the air. This protection is undoubtedly due to the continuity of the black fused layer of magnetic oxide with which these specimens are invariably coated,—a fact which Mr. M'Haffie, of Glasgow, has turned to useful account in a special furnace treatment, to which plates and other articles of wrought iron are subjected for the purpose of securing increased protection against air and water. The operation consists merely in imbedding the iron plates in powdered haematite, or other native oxide of iron, and heating to full redness for several hours, when a perfect layer of the protective oxide is formed; the plates are then allowed to cool gradually, and are found to be especially well adapted to shipbuilding purposes. Mr. M'Haffie, in his paper, also claims the use of oxide of zinc for producing an adherent black film, which in this case doubtless consists of a true comb nation of the oxides of iron and zinc, possessing an equal, if not superior, degree of permanence to that which has been already mentioned.

THE FLOW OF SOLIDS UNDER PRESSURE.

The most common mode of making lead pipe, is to melt the lead and run it into a massive cylinder, which has a hole in the bottom corresponding in size to the external diameter of the pipe; to the cylinder is fitted a solid plunger piston, which has a steel spindle, equal in diameter to the interior bore of the pipe, projecting from its lower end downward through the center of the die in the bottom. So soon as the lead has cooled sufficiently to become solid, but while yet very warm, the piston is forced downward by a powerful hydraulic press, squeezing the lead through the annular opening, and forming the pipe. A better form of the apparatus is to have a hole through the piston and let the spindle or core rise up through this hole from the bottom of the cylinder; on applying the pressure, the lead rises upward through the annular opening and flows over in an endless pipe. With this form of cylinder, pipe may be made from perfectly cold lead, and even from the still harder metal, block tin. Tin, indeed, can be worked only in the cold state, as it crumbles to pieces like sand if manipulated while hot.

It is manifest that the particles of the metals, when pressed through these openings, must slide upon each other in precisely the same way as the particles of water, or any other liquid, while flowing through similar openings. The resistance to motion in relation to each other of the partices of a liquid and those of a solid, seems to be merely one of degree. When the form of a bar of iron is changed, by either hammering or rolling, the particles must slip one over another, though they are not separated sufficiently to destroy their cohesion for each other.

This is an instance of the fading into each other of all divisions in nature. Nothing could seem more sharply defined than the distinction between solids and fluids; but if we change the conditions, if we subject the solid to sufficient pressure, it is found to flow through narrow openings, like the most mobile liquid.

LARGE CYLINDER CASTING.

Last week an immense cylinder was cast at the works of Mr. George Bayliff, Soho Foundry. The operation of casting was successfully performed and in a short space of time. The cylinder was cast with a steam jacket round it, and donkey arrangements for starting the engines. The cylinder is for a large pair of horizontal marine engines, in course of construction by Messrs. Laird Brothers, of Birkenhead. It is said to be one of the most intricate cylinders yet made, the weight being 30 tons finished. The arrangements for melting the iron were necessarily on a extensive scale. There were employed for the purpose two air furnaces, each containing fifteen tons of molten iron, and two cupolas. When the iron was melted and ready for being tapped out of the furnaces, it was run into two large fixed wells, so constructed with shutters and levers that one man to each had complete command of the metal whilst running into the mould. In addition to the wells, two ladles of molten iron, one containing seven tons, and the other five tons, were worked with the crane, in order to keep up the supply in the wells. The total weight of molten iron employed in casting the cylinder was about 40 tons. Being the first one of this kind, a few tons over the weight were, of course, considered advisable. —*Mechanics' Magazine.*

ART PRIZES.

The Architectural Museum offers some additional prizes to art workmen this year. The Council of this body offer a first prize of five pounds (given by the Architectural Union Company) for a boss modelled in clay, representing King David with his harp; the boss not to be less than nine inches over, and to be original in design. The Council offer a second prize of two pounds, and will adjudicate both. Also prizes for stone and wood carving, silver work, translucid and opaque enamels, and marble mosaic, the particulars of these competitions to be obtained of the secretary of the Architectural Museum. In addition to the above, certificates of merit will be given in deserving cases. All objects sent in for competition must be sent to the office entrance of the South Kensington Museum, by March 1st next. The objects will remain the property of the workmen or their employers.

The Art Directory of the Department of Science and Art has been published, and states, among other matters of interest, the following particulars of prizes to be offered in competition to all the schools of art in the kingdom. The prize list will include ten gold medals, distributed as follows:—1. For the best study from the antique, in chalk, monochrome, or modelled. 2. The best example of painting a group of still life from nature, in oil or water-colour. 3. The best study of the figure from life, in colour, chalk, or modelled. 4. Six medals for the best designs in the three classes architectural design, surface design, and plastic design. 5. One medal for a work of a class not included under the above named heads. Twenty silver medals, of which part will be given to the second best of the various subjects to which gold medals are assigned, and the rest to meritorious works in the same or the best works in other subjects of study. Fifty bronze medals to meritorious works in any of the various subjects of study. Messrs. Chapman and Hall are the publishers of the Art Directory.

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ON PURE WATER.

The very able article by Dr. Edwin Lankester is crowded out of our present number by pressure of matter, but will be continued in our next.

TESTING LOCOMOTIVE BOILERS.

On the 1st inst., the boiler of a locomotive belonging to the Great Northern Railway Company exploded near the Nottingham Station. Nobody was killed, and there will therefore be no public inquiry, but the first question which such an occurrence suggests to us is—Had the boiler been recently tested? It is curious that, in the face of a mass of evidence in its favour, the hydraulic test is never used on several of our principal railways. The Great Eastern, the North London, the South-Eastern, the Caledonian, and some other companies, do use the test regularly; but on the London and North-Western, the Great Western, and, we believe, also on the Great Northern and several other lines, it is not applied. On the Great Eastern Railway the boilers are tested as far as possible every twelve months, and the system is found to work well. The testing pressure is not excessive, being equal to about one and a half times the working pressure.

In the course of our own experience we have known several instances in which the application of the hydraulic test has revealed defects which, if not thus discovered and remedied, would, in all probability, have led to the most serious results. We do not consider that the hydraulic test is any substitute for a thorough external and internal examination of a boiler, but it is a most useful auxiliary, and it is a test which can be applied at times when an internal examination of the boiler is impossible. In the case of locomotive boilers especially, an internal examination is an expensive affair, necessitating as it does the removal of tubes, &c.: and, although we are far from advocating that false economy which would begrudge the expense of examining a boiler, yet we know that the question of cost is an important one in connexion with boiler working, and for that reason a test which can be cheaply applied is more likely to be used than one involving a great outlay.

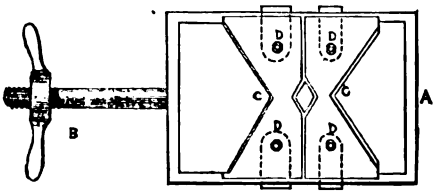
When a boiler is tested by hydraulic pressure, it should be completely stripped, so that it can be thoroughly examined during the time the pressure is applied. It would also be doubtless better if the principal dimensions of the boiler were checked before the pressure was applied, as well as during its application and after its removal, and any differences which may exist noted; but even without such precautions the degree of regularity with which the pressure increases under the action of the pump, and the constancy with which it is maintained, enable a person who has had any practice in the application of the test to judge very accurately of the state of the boiler under trial. The test is altogether, when carefully applied, a simple and effective one, and we sincerely trust that its use may become extended.—*Engineering.*

WORKMEN'S HOUSES, GREENOCK.—Workmen's houses are to be built at Greenock by the Provident Investment Company, which affords facilities for working men to become their own proprietors of houses. There will be six divisions of self-contained cottages, built of brick, in the English style, and there will be 164 plots of ground averaging 18ft. frontage, and 70ft. in depth. The houses will be kept back somewhat from the street to give additional airiness, and there will be space behind each for green and small garden plot.

THE VICTORIA BENEFIT SOCIETY.—In its place will be found the advertisement of this society, to which we have to call the attention of our readers. Judging by results already achieved, it seems to have struck root deeply. A glance at its rules, and at the list of its working committee, readily explains this success. It has branches—*not* at public houses—throughout the land, and whilst asking our readers to make themselves acquainted with the society, we repeat the words of Mr. Tidd Pratt, that "no human institution could be more beneficial than a friendly society founded upon proper principles."

PROGRESS OF INVENTION.

The following is a description of Mr. E. Merritt's Boring Collar, which was unfortunately crowded out of our correspondence last week:—A is the frame of wrought iron, 10 inches deep, 5 inches wide, made of inch bar, three-eighths thick, and provided with a tightening screw B to secure it between the lathe beds. C, C are two rabbeted slides, having bevelled V-grooved edges both above and below. D, D are four set screws, pass-



ing through the slides, being fitted to the tapped central parts of the braces E, E. It is plain that the slides C, C will hold any large or small works in their V-grooves, within the limits of the frame. I have, writes Mr. Merritt, shown it in the drawing arranged for a small article, but both slides are reversible, and to arrange them for large works the lower slide is taken off, the upper slide down, and the lower placed highest. Mr. Merritt states that he has had the collar in use some time.

WHITE PIGMENT.—Mr. John Dale, of Manchester, proposes to decompose the material called satin white, containing sulphate of lime and alumina, by chloride of barium, or of strontium, so as to replace, or partially so, the sulphate of lime by the sulphates of barium or strontium. The proportions to be used of the chlorides of barium or strontium will be according to the amount of sulphate of lime to be replaced. Secondly, he proposes to produce a substitute for satin white, by using caustic baryta or strontia, instead of lime as usual.

TELEGRAPHY.

ELECTRO-TELEGRAPHY owes much to Professor Wheatstone, but his latest achievement excels all we have yet heard of. With his improved automatic instrument, properly manipulated, he can transmit 600 distinctly legible signs or letters in a minute.—*Athenæum.*

LONDON DISTRICT TELEGRAPH COMPANY.—On the principal provincial lines having been restored this company are now able to receive messages for the provinces and continent, as well as for their own stations.

A TESTIMONIAL of a novel character has been presented to Professor Page, of the United States. The Bankers' and Brokers' Telegraph Company have tendered the use of their lines to the professor, "as a tribute to the many inventions and discoveries he has made in electricity and magnetism, and to his valuable contributions to the telegraphic art."

THE ELECTRIC TELEGRAPH.—In 1806 Ralph Wedgwood established himself at Charing-cross, and soon afterwards his whole attention began to be engrossed with his scheme of the electric telegraph, which in the then unsettled state of the kingdom—in the midst of war, it must be remembered—he considered would be of the utmost importance to the Government. In 1814, having perfected his scheme, he submitted his proposal to Lord Castlereagh, and most anxiously awaited the result. His son Ralph having waited on his lordship for a decision as to whether Government would accept the plan or not, was informed that "the war being at an end, the old system was sufficient for the country!" The plan, therefore, fell to the ground, until Professor Wheatstone, in happier and more enlightened times, again brought the subject forward with such eminent success. The plan, thus brought forward by Ralph Wedgwood in 1814, and of which, as I have stated, he received his first idea from his father, was thus described by him in a pamphlet entitled, "An address to the public on the advantages of a proposed introduction of the stylographic principle of writing into general use; and also of an improved species of telegraphy, calculated for the use of the public as well as for the Government." The pamphlet is dated May 29, 1815, and as the question of the merit of invention is one of considerable importance, I gladly give the extract, so as to establish the claim to that merit to a member of the Wedgwood family.—*Jewitt's Life of Wedgwood.*

THE PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, No. 73.—This number contains a series of useful papers on physics and philology. Of the former, we take as an example Mr. Chase's paper, on the declination of the magnetic needle. In this the writer endeavours to show that:—(1) The lines of equal dip are arranged in approximate parallels around the two (principal) magnetic poles. (2) In consequence of this parallelism, they are convex towards the north in the Pacific Ocean and towards the south in the Atlantic. (3) The magnetic parallels also approximate to the isothermal parallels. (4) The magnetic parallels near the magnetic poles are more convex than the isothermal lines. (5) This parallelism is especially observable in the region of the equatorial currents. The most important philological communication is that of Mr. Lesley, "On the Mythical Compounds of B A R." Altogether this publication is a valuable one, and deserves the attention of men of science.

BRITISH GOLD.

BY ROBERT HUNT, F.R.S.*

(*Continued from page* 208.)

The presence of greenstone or trap rocks has been already noticed; and it is a fact deserving of note, that away from the vicinity of those rocks, no good gold lode has been discovered.

The most important gold mines in North Wales are the Vigra and Clogau, from which, as we stated in our Chronicles of Mining in our July number, 10,778 ounces of gold had been obtained to the end of 1864. For some years, both the Vigra and the Clogau mines were worked for copper. They are now united as auriferous quartz mines, but nearly all, if not all the gold, has been obtained from the latter.

The Clogau St. David, No. 1 mine, is certainly the richest gold mine ever worked in the British Islands, and may compare favourably with the quartz reef mines of Australia. According to Mr. Dean, from a space of ground not more than 50 fathoms long by 30 fathoms deep, and only a portion of which has been worked away, there had been extracted at the 31st of May last, and reduced 4,154 tons of quartz, yielding 11,508 ounces of gold, giving an average of 2 oz. 15 dwts. 19 grs. per ton. Taking this lode as a type of those which occur in its neighbourhood, it will be well to describe it.

The lode has an average bearing 15° N.E., and is intersected by a very powerful cross-course, bearing 30° N.W., and dipping slightly S.W. The lode traverses beds of indurated Silurian clay slate, which are interstratified with thick beds of greenstone. There is also a large greenstone dyke, which is traversed by a portion of the lode for a length of about 60 fathoms, until they are intersected by a great cross-course. Behind this cross course the lode is extremely rich in gold. It should be stated that the lode is composed almost entirely of quartz, with here and there some carbonate of lime. Throughout the quartz, yellow copper ore is, in small quantities, disseminated as well as gold. Where the gold is most abundant, Telluric Bismuth in fine silvery white grains is generally present, and an opinion prevails that whenever that mineral is met with, gold is near at hand. It was commonly supposed that gold is only to be found near the surface. Mr. A. Dean has favoured us with some notes on this point, which are exceedingly important if all the conditions have been correctly observed. Without comment, Mr. Dean's own words are given:—

* Extracted from the *Quarterly Journal of Science* for October. Churchill and Sons.

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"The opaque white quartz floors, which are comparatively poor in gold, alternate with others of a greenish white colour, very dense, and of a shining conchoidal fracture; the latter are the rich gold-bearing floors; we have, therefore, alternate rich and poor floors. From the dip of the floors the deposits of gold appear individually to dip eastward, but, as the bands of clay-slate forming the walls of the lode below the greenstone dip westward down to the cross-course, the succession of bunches of gold in the alternate floors of greenish quartz follow the dip of the clay-slate. This is an important point in relation to the recurrence of rich deposits of gold in depth below the present bottom."

This quotation sufficiently indicates the hypothesis that with a recurrence of the same conditions in depth, rich, or perhaps richer, deposits of gold may be met with. There is a very close analogy between gold and tin. It was an opinion, held with much obstinacy for a long period, that tin would never be found deep in the earth. Experience has now proved the fallacy of this, for the most abundant deposits of tin are now worked at depths of between 200 fathoms and 300 fathoms from the surface. The result of sinking on the quartz lodes in the mountains of Merionethshire will be watched with much interest.

Invariably when a good mine is discovered, a great many other mines are started in the neighbourhood. This applies to every variety of mine exploration, and is especially applicable to gold mining. Numerous attempts and failures have hitherto marked the progress of mine adventure in North Wales; and it is generally believed that more gold has been expended on the Welsh hills than has been obtained from them. The authority whom we have already quoted, speaking of the poorer varieties of quartz, says:—"The Clogau Company has stamped 2,500 tons of poor ores, yielding an average of 12 dwts. per ton; and during the last two months the Castele Carn Dochan Company has stamped 200 tons of the mineral broken indiscriminately from their lode, with an average of 15 dwts. of gold per ton. With good reduction machinery several of the gold mines in the Dogelly district might yet be made to pay." It will be most satisfactory to find the hopes thus expressed by Mr. Dean fully realized. It is right that some idea should be given of the occasional richness of this auriferous quartz. Mr. T. A. Readwin informs us that by far the richest discoveries of gold have been made at the Dol-y-frwynog, Prince of Wales, and the Clogau Mines. He has, he states, extracted gold from stones, from each of these mines, at the rate of 300 to 400 ounces to the ton. At the same time as he draws attention to the exceeding richness of some specimens of the auriferous quartz, Mr. Readwin says, with much honesty, "I beg distinctly to state that the average yield will not, in my opinion, exceed half-an-ounce to the ton of ore."

(*To be continued.*)

VAN CHOATE'S SUBMARINE TELEGRAPHY.

I.

(*Illustrated on page* 234.)

LETTERS Patent have been granted in this country to Mr. Van Choate, telegraph engineer, of New York, for "an improved system and apparatus for facilitating the working of submarine cables and other conductors of electricity," the various arrangements connected with which are exhibited in the accompanying engraving, the description of which will be found, at least, interesting in connection with the inventor's reasoning, which proceeds somewhat as follows:—

In Figure 1 is represented a cable, the batteries, &c. arranged for working a line. Also a section of the earth with the banks on either side, the sea between, and the cable near the bottom, on each shore an office, A^1 being the sending, A^2 the receiving station. In this arrangement two distinct batteries supply the galvanic current, one, B, at the sending, the other, M, at the receiving station, it being found that one battery would not have sufficient intensity to project a current through the entire length of the cable owing to the retardation the conductor offers to the passage of the electric fluid. The current is diminished as it recedes from the battery; and a battery is placed at each end of the conductor to maintain the intensity of the current throughout the cable necessary to work the apparatus.

Electrical phenomena, so far as practical telegraphy is concerned, are based upon the idea that there are two kinds of electricities to a current, positive and negative, and that when a circuit of wire is formed enclosing a battery a circulation of the fluid from the positive to the negative poles takes place. Practice seems to confirm this theory. It is well known that when to each pole of a battery two pieces of wire are connected, there will be no perceivable electrical action while the other ends of the wires will be separated as in Fig. 3; but when the ends of the wires are brought together, as in Fig. 4, a circuit being completed, action is instantly produced. This should be distinctly understood in order to perfectly comprehend the matter beyond.

Steinheil, of Munich, demonstrated that the earth might be made the equivalent of one part of such an electric circuit; that when a wire is connected with the ground at one end, and is run out to any given point, and the other end connected with the ground also, there is then an equivalent to a metallic circle.

It is necessary to mention the fact that the electric fluid will invariably take the shortest route, conductors being equal in order to complete a circuit, passing sometimes in a mysterious manner to accomplish this purpose. It is important that this fact should also be remembered, so that the most important difficulties as affecting practical "cable telegraphing" may be fully comprehended and explained.

Returning to the idea of the attenuation of the current, it will be endeavoured by the aid of Fig. 1 to illustrate it, showing by the arrows intended to represent the currents and their direction that the greatest intensity is at the starting point, battery B, and that at D where the cable first meets the water the current is stronger than it is at E, and that at F near the centre of the ocean there is scarcely any current at all. The same thing may be observed at the other end or receiving station, battery M supplying the current at that point. The greatest strain upon the insulation of the cable is at D and K where the first contact with the water is made near each shore; consequently the greatest escape of the current through the coating or insulation of the cable takes place at these points, diminishing as the distance from the battery increases toward the centre at E and J. The current thus escaping takes the shortest distance through the earth to the other pole of the battery, forming at each end a perfect circuit; that at the sending station completing a circle through battery B, and C, D, O, ground plate A, and back to B; that at the receiving station through battery M, ground plate N, and O, K, L, and back to M. The resistance that the increased length of the cable offers to the passage of the current being greater than the resistance of the coating or insulation the fluid finds an easier transit than through such insulation and the earth back to the opposite pole of the battery than through the entire cable from shore to shore.

In Fig. 2 there is understood to be shown a cable whose conductor is supposed to be perfectly insulated, so that the current is made to circulate through the entire length from shore to shore, returning through the ground below, forming a perfect galvanic circle including both the sending and receiving apparatus. Should a break or disconnection be made at any point within this circuit, a perfect disturbance of the galvanic action would be produced. In this case the insulation offers a greater resistance than the resistance offered by the length of the wire or conductor, so that the current finds an easier passage through the entire length of the cable circuit than it would to pass through the insulation and ground at D, O, and K, O, consequently a short circuit at the two ends of the cable is not formed.

The current, it has been seen, cannot pass unless the circle is complete. It will be seen by referring to B^1, Fig. 2, that the wire or line is disconnected at C, which point we are to suppose is at the manipulating key of the sending instrument. It will be noticed that when this space or opening is closed that a circuit is completed following the direction of the arrows toward D, and through the cable to K, receiving instrument L, battery M, ground plate N, and the earth to ground plate A, completing the circle at battery B. This circuit is based upon the supposition that the wire is perfectly insulated, and that no escape of the battery fluid takes place along the cable.

Telegraphing consists simply in systematically breaking and closing the galvanic circle, which breaking and closing produce disturbances upon receiving magnets. These disturbances are translated into letters of the alphabet.

In all cases heretofore the breaking and closing of the galvanic circle has been at the sending station or instrument. If an attempt was made to make more than one break in a circuit at a time the operator immediately lost control of the line, that is to say, he could not again close the circuit, except at the point where his breaking key was. Hence the breaking of the circuit has only been practicable at the position occupied by the transmitting operator.

Return now to Fig. 1, where it is shown that the retardation, resistance, and imperfect insulation of the conducting wire of the cable has caused the electric fluid generated by batteries B and M to escape and move back, passing through the earth and water to the respective poles of the batteries, thereby forming two distinct circuits, one at the sending station and one at the receiving station. If the insulation had been perfect, and the resistance not too great, the current from the batteries would circulate freely through the cable from end to end and return through the ground to the starting point, as indicated in Fig. 2. Now suppose the illustration in Fig. 1 to represent a cable of 2,000 miles long successfully laid down, but the insulation imperfect and the resistance great, and the batteries and instruments all arranged for working in the usual way, if the line circuit be closed through the batteries the current will pass out on the line, but meeting with the resistance and imperfect insulation, it escapes and turns back at each end in the direction indicated by the arrows as at D and K, forming the two circuits before described at A_1 and A^2, Fig. 1. Suppose a message is to be sent from the instrument at A_1, Fig. 1, to the receiving apparatus at A^2, same Figure. The operator at the sending station opens his key or breaks the circuit at C. It will be observed that this would of course cut off the entire current from battery B, and consequently destroy the circuit formed through C, D, O, A, and B, Fig. 1. But the object is to disturb the receiving instrument at the other end of the cable, and it will be seen that that instrument is enclosed within a circuit formed through M, N, O, K, L, Fig. 1, at that end of the cable, and that this circuit, which is abnormal, is entirely beyond the control or influence of the operator at the sending station. This abnormal circuit is the great difficulty; can it be obviated? Suppose we take away the battery at the receiving station which forms this abnormal circuit beyond the control of the sending operator? The consequence would still be the same, because the battery at B will not project a current through the entire length of the cable to the receiving station, and without electricity the receiving apparatus cannot be operated.

From this it will be seen that the sum of the difficulties affecting the successful working of long stretches of cables lies in these simple facts:—First, that the electric fluid, owing to its becoming attenuated, fails to reach the receiving apparatus in long stretches with a single battery located at the sending end. Second, that a battery placed at the receiving end forms a short circuit at that point. Third, that the breaks and closings of the circuit at the sending instrument fail to produce a corresponding disturbance in the closed circuit at the receiving end, and consequently the normal state of the receiving apparatus at the receiving end or station remains unaffected.

Now for the mechanical devices and the system

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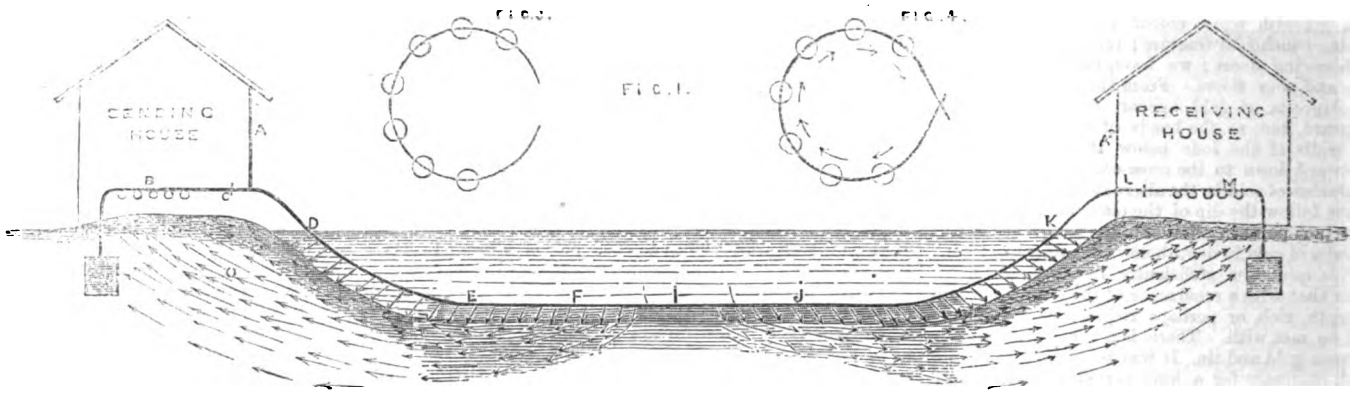

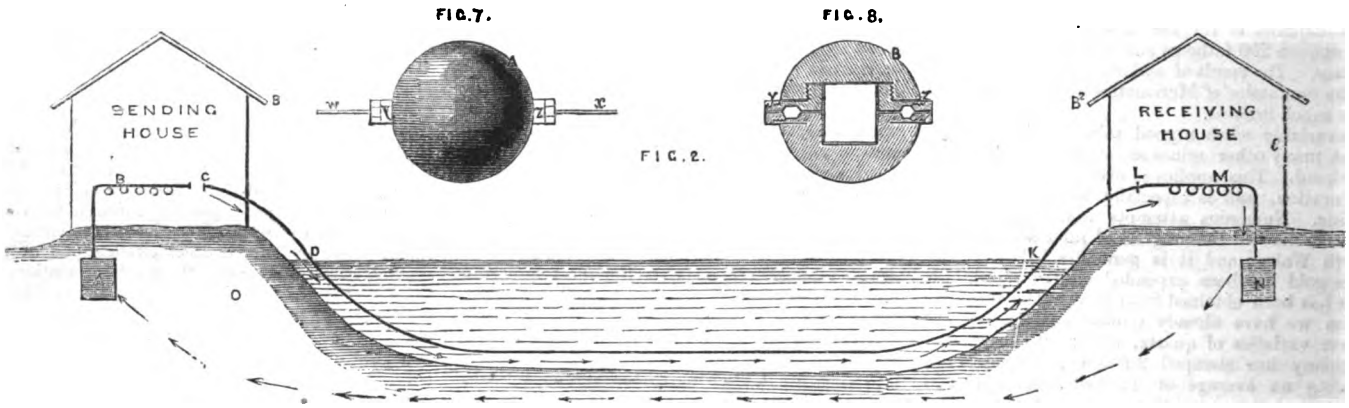

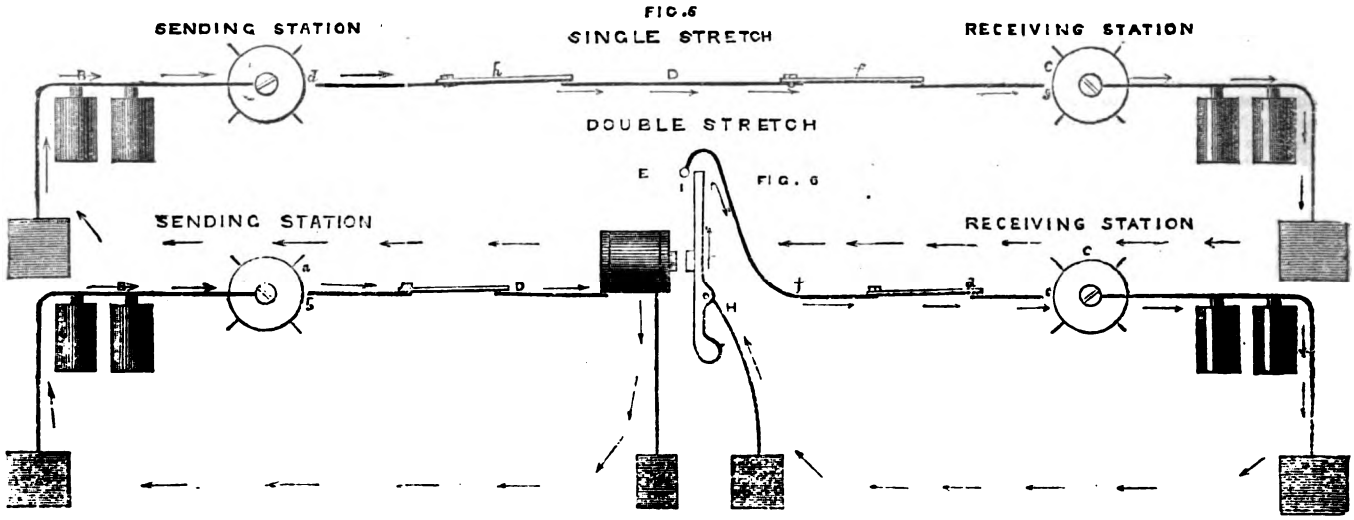

invented by Mr. Van Choate to overcome these difficulties and operate such lines with rapidity.

In his system the employment of printing instruments is contemplated, although other kinds of apparatus may be used in their place.

The invention possesses two distinct features, and the mechanisms are arranged to—First, facilitate the working of lines and cables of a given length; and second, to practically work and with rapidity lines and cables twice the length or distance that can be done by any other system or apparatus ever before known or used. We will first describe the plan and arrangement to facilitate the working of a line or cable of a given length, and which is represented at Fig. 5, wherein A, A, indicate the two ground terminations of the line, and B, B, the two batteries, one at each end of the line or cable C, C, representing two revolving circuit breakers or closers, one located at each end of the cable, while D is intended to represent the cable which connects the two revolving circuit disturbers C, C. The mode of operation of the apparatus arranged in this way is as follows:—

The two revolving wheels C, C (Fig. 5) are both combined with proper mechanical devices, whose functions are such as to keep them (C, C) in unison, that is, moving at the same speed, and so arranged that where they both start or are set in motion at the same time they perform their revolutions precisely in the same space of time, and by proper mechanism their speed is regulated as desired. Each of these revolving wheels is armed with exactly the same number of projections, which correspond in number to the characters on the type wheel arranged to give the signal or signals to be interpreted as the dispatch produced by the influence of the electric impulse. The line starting at the sending station at A, or battery B, would take the direction of the arrows, and the metallic connections being suitably arranged, the current would pass through the revolving wheel C, and whenever one of its projections came in contact with a contrivance properly arranged at *d*, the open space at that point for the instant would be closed, thus completing metallic connection with that portion of the conductor between the ground A, battery B, wheel C, space *d*, and key or circuit closer *h*. It has been shown before that the magnetic circle cannot be formed unless the conductor is perfect or continuous. It will be seen at Fig. 5 (sending station) that the current has started from A, or battery B, and has passed through wheel C, and space *d*, but has reached another open space *e* at the key *h*. Now, by the manipulation of the transmitting operator or otherwise, space *e* can be closed, when the electric current would proceed in the direction of the arrows along the cable D, and on uninterruptedly to *g*, where is seen another open space which would again stop its further passage.

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THE LATHE AND ITS USES.*

II.

ANY one who has watched a novice at work on a lathe must have remarked the difficulty he has in controlling the tool and keeping up the motion of the treadle at the same time. The two operations are difficult to "get the hang of," to use a homely phrase; but once conquered, the work can proceed. The natural tendency is to slack up or stop the motion of the treadle while the tool is engaged, and the tool is, therefore, at one time under the work, at another time above it, at another jumping rankly in, until, finally, the piece goes whirling out of the centres or the chuck, and the operator flushes all over at his awkwardness.

This, of course, is remedied by practice; and as this article is written mainly for the information of beginners and amateurs, we hope that experts and those who know all about hand lathes will excuse allusion to such simple things as holding the tool properly, and kindred matters.

The lathe must be of such a height as the workman finds most convenient, so that he is not obliged to stoop much, and, at the same time low enough to allow the weight of the body to be thrown on the tool when hard work is to be done. The speed of the lathe ought to be very high on

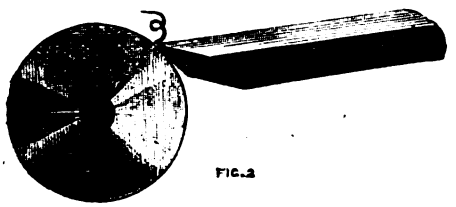


FIG. 2

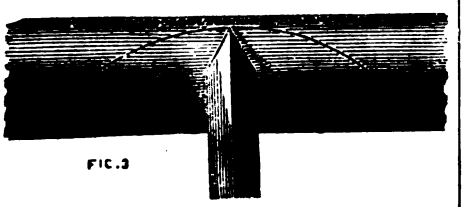


FIG. 3

the smallest cone, and there should be three speeds at least for different work. The object is to regulate the velocity of the work in the lathe, and keep the motion of the treadle uniform, as near as may be, at all times. It distresses a workman greatly, when chasing a fine thread on a small diameter, if he has to tread fast to get up the proper speed, as he does when there are only two speeds. On the contrary, for larger jobs, it is difficult to keep up a rotary motion if the foot moves slowly, as it must in order not to burn the tool by a high velocity on some kinds of work. Foot lathes in general, are not geared, although some are, and ought to have wider ranges of speed than they do. Where one class of work is done, however, it makes little difference, but for general turning the speed should vary.

Another difficulty experienced by beginners is in holding the tool still—*rigidly so*. They allow it to "bob" back and forth against the work, if it runs untrue, that so it is impossible to make a job. The tool must be held hard down, as if it grew to the rest, and never moved, nor receded, until the cut begun is finished.

The "rest" should be of soft wrought iron, since that material holds a tool with more tenacity; imposing less strain on the arms of the operator. It should be dressed off smooth as often as it gets badly worn, or cut by indentations. Cast iron is not good and steel is not so good as wrought iron. A special rest should be kept for chasing threads with, since the least obstacle is enough, when running up a fine thread, to divert the chaser and spoil the job, by making a drunken thread. If we now suppose the lathe to be in good order, the centres true and well turned to a gage, the rod (if that is the job) between them, and properly "dogged," the centres oiled, and the rest at the right height, we shall be all ready to start. The rest should be high enough to bring the point of the tool a little above the centre.

To rough off the outside, and make it run true, is the first step, and the tool must, therefore, be held as in Fig. 2, or so that the point and part of the edge alone engages with the work. This will take off a thin spiral cut without springing the shaft or making it untrue. The whole surface of the shaft must be thus run over, beginning at the right hand and shifting the tool as fast as one part is turned. The tool should not be moved rigidly in a straight line toward the belt, but by holding it hard down on the rest, so that the bottom edge bears as in Fig 1, (see last article) and rocking the tool on that angle, so that the point describes a curve as in this view. The work will be turned evenly and true.

We must remark in passing, that the person who reads these directions and then undertakes to turn by them, will find that reading how to do a thing and doing it are two different matters.

It looks very nice to see a skater darting over the ice at his ease, but, try it once, and, if you never knew before, you will understand what experience means. Trying to teach a person to be a turner in a newspaper is analogous. One can only indicate the general method, and leave experience to do the rest.

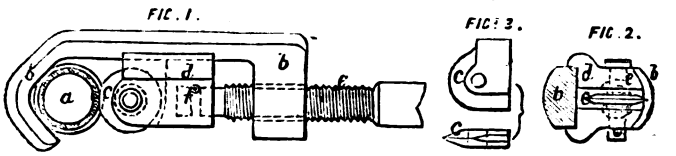
After the whole surface has been run over, the same tool may be used on the flat side for reducing the work to one diameter throughout the length. The reader must not assume that there is no other tool than a diamond point; he will find many others adverted to, as we proceed.

* Mostly compiled from *American Journals*.

CUTTING PIPES.

This, the invention of Mr. John Wolstenholme, of Ratcliffe, Lancashire, relates to the cutting of pipes or bars of metal by means of a circular cutter revolving in a bush, which slides on a hooked piece of steel or other metal. Fig. 1 is a front view, and Fig. 2 a plan, partly in section, of the improved implement for cutting pipes and bars of metal. *a* is a section of a pipe which is supposed to be partly cut through, and *b* is the hooked piece forming the upper part of the improved implement; *c* is the cutter revolving in the bush *d*, which slides on the side of the piece *b*, the lower end of which is screwed like a nut. In the lower part of the bush *d*, is a recess to receive the end of the handle *e*, the bush and handle being connected by the pin *f* fitting in a circular groove in the end of the handle, the upper part of which is screwed into the piece *b*. The mode of operation is as follows:—The pipe or bar to be cut is securely held in a vice, or otherwise, and the circumference of the cutter *c* is brought against the circumference of the pipe or bar by turning the handle *e*; the implement is then turned round, and the cutter is gradually set up by turning the handle *e* until the pipe is completely cut through, or until the cutter has penetrated the bar to the required extent; the screw *e* is then turned back to liberate the implement, and the bar in which the groove has been cut can then be broken in two by a slight blow. Fig. 3 represents a modification of the invention: in this case, the circular rotating cutter *c* is replaced by a tationary cutter fixed in the bush *d*. The patentee claims, "the improved implement for cutting pipes and bars of metal, as shown and described, and particularly the rotary cutter *c*."—*Newton's J. A.*

WOLSTENHOLME'S CUTTING PIPES.



RIVETTING MACHINE.

Mr. Kennard, of the Viaduct Works, Crumlin, some time since received provisional protection for certain Improvements in Machinery for Rivetting and for making Rivets, which we are about to describe. Though he proceeded no farther in the matter, others may be able to couple parts of the improvements with their own, and proceed to a more successful issue than did Mr. Kennard, to whom we sincerely wish "better luck next time." Mr. Kennard's invention consists in an arrangement of that description of machinery for rivetting together metal plates in which both heads of the rivets are formed during the process of rivetting, which arrangement is also rendered applicable to the making of ordinary rivets when the machine is not employed for rivetting. For this purpose a strong framing is provided with two uprights, so situated that the object to be rivetted can pass between them. In these uprights there are arranged two sliding rams or pistons, the one situated opposite the other, and each carrying a die or cup for forming the rivet heads, so that when the object to be rivetted is passed between the two uprights (being held and guided in its motion by guide rollers) and a length of heated rivet iron has been inserted into the hole formed in the object to receive it, both pistons or rams with the dies are caused to advance, and by acting simultaneously upon each end of the rivet iron are made to form both heads of the rivet at once. The requisite motion for this purpose is imparted to the pistons or rams by means of two double ended levers, the ends of each of which are connected respectively by links to the extremities of the rams and to the extremities of a toggle joint. The elbow of the toggle joint is connected by links to a double-ended lever, of which the long arm is connected to and receives motion from an eccentric or crank upon a revolving shaft, receiving the requisite rotary motion from the driving shaft through suitable speed reducing gearing. The fulcrum of the last-mentioned lever is carried by the short arm of another double-ended lever, the long arm of which is weighted to an extent corresponding with the pressure to be exerted by the rams, whereby the pressure of the rams is rendered of a yielding nature so as to allow for the difference in thickness of the objects to be rivetted. This machine may also be employed for forming ordinary rivets instead of rivetting, for which purpose the before mentioned uprights are provided with bearings situated above the sliding rams, in which bearings, when the machine is not employed for rivetting, is placed a hollow shaft carrying a hollow disc, which disc receives a rotary motion between the sliding rams by means of a ratchet wheel fixed upon the hollow shaft. Inside the hollow disc is situated a second disc, the surfaces of which are formed as inclined planes tapering from top to bottom, and which disc divides the space inside the hollow disc into two compartments. This inclined plane disc is held stationary whilst the hollow disc revolves by means of a spindle attached to it which passes through the spindle of the hollow disc and is fixed to the framing. In the circumference of each side of the hollow disc are formed holes, which as the disc revolves, pass in front of each of the sliding rams, and into these holes, when near their lowest position and approaching the rams, are inserted lengths or "blanks" of rivet iron heated at the projecting end upon which the head is to be formed. The blanks are pushed into the hollow disc until they come in contact with the before-mentioned stationary inclined plane disc, so that when the ends of the blanks projecting from the hollow disc are brought before the sliding rams and these are made

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to advance, their dies or cups press against such projecting end of the blanks and form them into the required rivet heads. As the hollow disc in revolving carries the formed rivets up away from the rams, the fixed inclined plane inside pushes the rivets out of the holes of the hollow disc to make room for fresh blanks.

MACHINERY OILS.

Mr. J. Hall, of Nottingham, has acquired Letters Patent for the manufacture of oil for the use of machinery. The invention consists in the manufacture of oil from the fat of oxen, &c., in the following manner:—Any required quantity of the fat is placed in a cauldron which is placed over a stove until the fat has become thoroughly dissolved. This fat is then run through a series of sieves to extract the refuse from it, and there is then poured into the vessel which has received the fat, and whilst the fat is still in a liquid state, a quantity of colza oil. The vessel containing these two ingredients is then placed on a heated surface, and the matters mixed well together by stirring. Then the liquid is clarified by placing dry coffee or other equivalent in a bag of muslin or other equivalent, which is inserted in the liquid, which is then stirred or otherwise mixed. The liquid is then filtered through flannel, next through thick paper, and subsequently through fine paper; when this has been done the oil is fit for use. The oil thus manufactured contains less water than is contained in oil heretofore produced, and the patentee claims that his oil is better and purer in quality and produces less dirt in machinery when it is used therein.

SCISSORS, SHEARS, AND EDGE TOOLS.

The "idea" following, received provisional protection only, but as others may be working in the same direction we have thought fit to publish what has been done by Mr. C. Lingard, jun., of New York. His object was to make cast iron available in the manufacture of scissors, shears, &c., and to weld or attach thereto cast steel to form the cutting parts. He proposes to form the bows and blades of scissors and shears, and all but the cutting face of edge tools of malleable cast iron. When cast of the proper form, they are placed in vessels and surrounded with red ore and smithy slack, mixed in about equal proportions; then the vessels are to be placed in a close furnace of the construction ordinarily used for annealing cast iron, and subjected to the action of heat for about 190 hours, and during nearly the whole of that time the furnace is to be maintained at a regular heat, assuming a bright cherry red color when looked at through an aperture. The furnace is then to be opened and the pans allowed to cool gradually—when cold the contents are withdrawn; they are then ready for being subject to the welding process.

The part of the bows or edge tools to which the steel has to be applied to form the cutting face is then placed in contact with steel forged to the proper size and heated in an ordinary smith's fire until they attain a welding heat approaching a straw colour. To the surfaces designed to be welded borax is applied boiled from a liquid to a state of dry powder; the surfaces are again placed in contact, hammered together, and manipulated in the ordinary manner. The articles afterwards to be finished in the usual way.

AN IRON THEATRE FOR THE DIGGINGS.—A theatre for the "new rush" at Hokitika is being constructed in Sydney, under the superintendence of Mr. James Bartlett and Mr. W. Dind, with a large hotel attached. The building is of iron, and will be 150 ft. long, 45 ft. wide, and 28 ft. width of stage, with a depth of 30 ft. There will be a dress-circle, stalls, and pit, and a handsome portico entrance. All the decorations and scenery are to be made in Sydney, and taken down with the building. The hotel is to be fitted with every convenience, including bath-rooms, and will have two American bars, 20 ft. by 15 foot.

PROGRESS OF PHOTOGRAPHY.

THE OPAL OR TRANSPARENCY PRINTING FRAME.

At the monthly meeting of the North London Photographic Association on the 3rd instant, W. W. King, Esq., in the chair, F. W. Hart, Esq., exhibited a new description of opal or transparency printing frame, and gave the following explanation of the invention:—

In placing my model for opal glass printing before you, I will, previously to illustrating its action, state the problems that had to be solved in its construction.

1. It is imperative that the negative shall be so held as to preclude the possibility of its falling away, with the consequent risk of injury.

2. It is necessary that the negative, when safely held as above, shall permit of any size of opal or other plate, smaller or larger, being brought into contact with any part of it. To make this plainer, you are aware that the image on the plate is not always in the centre, for many reasons. Again, 2, 3, 4, and 8 on a plate are in constant use in usual printing; it is desirable that any single one, even of the eight on a plate, should be adjustable to the centre of any small-sized opal plate.

3. That the opal or other plate, oval, square, or any other shape, be readily adjustable, and retained with firmness during the operation of printing.

4. That the apparatus shall ensure parallelism when used with glasses of any thickness, and shall retain it thus, to enable inspection to be made during printing.

I will now proceed to demonstrate the practical working of the apparatus before you. In the first place, we will select a plate with four *carte* negatives. It is desired to print from the lower right-hand corner picture. We place the entire plate in the < groove of the upper frame, which takes any size. It can, consequently, neither go forward nor backward, and thus the first and most important proposition of the problem is solved—immunity from breakage. The surface to print on is now laid under the part of the plate desired, and by means of the three clamps on the diagonal bed it is firmly fixed in its place. The registering frame and screw button are then fixed down. We now relieve the side screws, and the bed comes up and adjusts itself to the negative. The side screws are then tightened again, and the picture put in the light to print. The upper frame can of course be lifted as often as desired. By removing the screen at the back its quality as a transparency can be judged of. In conclusion, as cabinet making is not a speciality of my business, I shall be happy to afford camera makers or others an opportunity (on application for appointment, by letter addressed to me at 52, Canterbury-road, London, N.) to fully inspect the apparatus.

A vote of thanks was accorded to Mr. Hart for bringing the apparatus under the notice of the Association, and for his kindness in offering to assist any one in constructing such a frame.

NEW INSTANTANEOUS SHUTTER.

Mr. Taylor said he had been permitted by Mr. Swan, of Newcastle, to exhibit a new instantaneous shutter which that gentleman had invented. Mr. Swan had arrived in London that day, and, but for the circumstance of his being very much fatigued, would have done himself the pleasure of attending the meeting. The ingenious apparatus which he had invented had for its object to effect an instantaneous exposure. It was put in the place of the ordinary diaphragm, and its action depended upon one spring pulling against another. It was so arranged as to be something chronometric in character; *i. e.*, the duration of exposure could be adjusted within certain limits.

Mr. Swan, at this period of the meeting, entered the room, and was very cordially received. He was invited by the chairman to furnish the Association with some further information in reference to his invention. Having prefaced his remarks by expressing the satisfaction it afforded him to meet the members of the Association, he said: It has long seemed to me to be a desideratum when taking instantaneous photographs, to be able to vary the time of exposure. We all know that in taking ordinary photographs—not instantaneous ones—the quality of the result depends in a great measure upon the proper time of exposure; and in taking instantaneous pic-pictures, I think that fact has been a little lost sight of. The exposure has been to a great extent a sort of hit or miss, and the obtaining of exactly the right exposure is too frequently a matter of accident. By means of this shutter I have tried to cut up into small fractions a second of time, in the same way as we cut up a minute by means of our watches. I have taken advantage of the law of falling bodies, *i. e.*, the uniform rate at which bodies fall. By means of a small ball falling through a limited space, which space is adjustable, the shutter is raised and closed, and the duration of exposure varied accordingly. This shutter is intended to go in the tube of the lens in the place usually occupied by the diaphragm; and in this, I think, there is considerable advantage, because at that particular place the aperture is at the smallest, and of course the period occupied by the travelling of the shutter is reduced to a minimum, while the period during which the aperture of the lens is fully used is at its longest, by having the shutter to occupy that place. The sliding shutter is made of aluminium for the sake of lightness; and being put in the place of the diaphragm of an ordinary lens, it acts the part of the cap to stop the light. By pressing a trigger gently the cap will be raised, and on the instant, by the act of rising, the ball is disengaged and immediately commences its fall. The length of time during which the shutter remains up is the length of time occupied by the ball in coming to rest. In coming to rest it gives the cord a slight tug, and thus produces a second action in the shutter, causing it to close. The ball is not an essential part of the apparatus; it can be used without the ball, especially with ordinary photographs. In taking portraits, the attention of the sitter is rather apt to be diverted by the putting on and taking off the cap, and this inconvenience will, I think, be diminished by the use of this little apparatus. I ought to say that this shutter has been made by Mr. Cooke, of Newcastle, to whom I am indebted for the neatness with which my idea has been carried out, and for the general elaboration of the apparatus.

The Chairman, in offering to Mr. Swan the cordial thanks of the Association for bringing this beautiful instrument before the meeting, said he felt sure that the invention would be of great service to photographers by aiding them to attain more certainty in the time of exposure than had hitherto been practicable. This invention he was convinced would not be one of the least of Mr. Swan's solid contributions to the photographic art. The Association was much indebted to the circumstance which had made Mr. Swan their visiter on this occasion, and he trusted they might often have the pleasure of welcoming his presence at its meetings.

MANUFACTURE OF NAILS, SPIKES, &c.

In the illustrated article in Number 42, on Mr. Whittle's improved machinery, an error has crept in which confuses the description. The fig. 3 *described* has been inadvertently omitted; that which now appears as fig. 3 should be numbered 2; that which is numbered 2 should be altered to 4. If readers will kindly make the correction in their copies, confusion will be avoided.

A WORKING MAN'S CLUB HOUSE AT SUNDERLAND.—The working men of Sunderland finding their present club building too small for their purpose, have formed a company to purchase the Fenwick mansion, at £1,100. The capital is to be £4,000, in 4,000 shares of £1 each. The mansion contains nineteen rooms, and there are about 900 square yards of ground, and it is estimated that £900 will be required to make the needful alterations, and to erect a lecture room capable of holding 500 or 600 persons.

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ASTRONOMY.

In 1862, says a writer in the *Galignani*, we gave an account of M. Von Gumpach's work on the "True Figure of the Earth," and we will now mention a pamphlet he has published entitled, *Our Weekly Gossip*, in which we find a series of polemical papers addressed to those who in the *Athenæum* and elsewhere have repudiated his doctrines with more or less reason or acrimony, in which latter quality M. Von Gumpach is by no means himself deficient. Our author, as we stated on a former occasion, asserts that the earth is not a *compressed*, but a *prolate* ellipsoid, or in other words, that it has not the figure of an orange but of a lemon. Now why, according to Newton, and the dominant school, has it that of an orange? First, because in measuring various arcs of an earth's meridan it has been found that the degrees are longer towards the pole than near the equator. Secondly, because the seconds' pendulum is longer at the poles than at the equator, its length being a function of the force of gravity, and increasing with it. And, thirdly, because, in consequence of the earth's diurnal rotation, its particles at the equator are actuated by a centrifugal force which is zero at the poles. Now, none of these arguments are theoretically conclusive; as to the first, because a prolate figure is infinitely more favourable to an increase of length in a polar degree than a compressed one, as any one may see by merely taking the trouble of using his compasses and describing on the same equator, first, a compressed ellipsoidal quadrant, then a circular one, and then a prolate ellipsoidal one. As to the second argument, because if on the one hand it may be argued that gravity increases at the poles because in a compressed ellipsoid the distance from the earth's centre is shorter, on the other hand it may be argued with equal force, that gravity increases at the poles of a prolate ellipsoid, because of the greater quantity of attractive particles accumulated there. And lastly, as to the third argument, it may be replied that in a rigid body like the earth the effect of the centrifugal force must be zero, and that if it were not, the earth would by this time have become as flat as a pancake by constant rotation. The origin of the idea of this action of the centrifugal force lies in the purely gratuitous supposition that the earth was once a fluid mass, an opinion in favour of which there is not a shadow of evidence; nay, we have evidence to the contrary, for all the aeroliths that have fallen on our earth, and which may, within the compass of our present knowledge at least, be considered as abortive planets, are solid. That there is "something rotten in the state" of astronomy cannot be denied, even on the showing of astronomers themselves, who are constantly complaining of something that does not tally with observation, and we therefore strongly incline towards such innovators as M. Von Gumpach and M. Charles Emmanuel; but to the former gentleman we beg to suggest the good policy of not losing his temper, and endeavouring to combine the sweetness of the dove with the wisdom of the serpent.

RESTORING A DISORDERED BATH.—A correspondent of the *Photographic News* says:—"Having had an old bath which seemed almost beyond cure, giving persistently stains and markings, after various remedies I tried the following:—"I put into the solution sufficient distilled water to turn the solution turbid; I then put it into an earthen vessel and boiled it, or otherwise simmered it for two hours. After cooling, I tested the same, which was at 90 grains to the ounce; I then made it to 35 grains, and on trying it with litmus paper I found it to be neutral. I then made it slightly acid with 'nitric acid,' and I again commenced taking negatives. It worked excellently; the negatives came out full of detail, giving more sensitive plates than before treatment."

DR. PERCY ON METALS.—Last week, Dr. Percy gave the first of a course of six lectures upon "Metals," at the School of Mines, Jermyn street. The lecture room was crowded by the working classes, who gain admittance at the small fee of sixpence to the whole course of lectures.

RECENT AMERICAN PATENTS.

Water Wheel.—This invention relates to a new and improved water wheel, of that class which is placed in a scroll, and is on a vertical shaft, and commonly termed horizontal water wheels. The invention consists in a new form of bucket and its arrangement on the wheel, whereby it is believed that the direct force of the water, and also its reacting force, are obtained with a more favourable result than hitherto. Uriah H. Goble, of Dubuque, Iowa, is the inventor.

Pump for Oil and Other Deep Wells.—The object of this invention is to produce a pump for operating deep wells—such, for instance, as oil wells—and it consists, among other things, in securing the cylinder within and near the lower end of the ordinary well tube, which is usually carried down to, or nearly to, the bottom of the well. It also consists in extending the well tube, or that portion thereof into which the bottom of the pump cylinder is secured, some distance below the pump—the extended part being perforated with numerous holes, to admit oil or other liquid, as well as gas, to the valve in the bottom of the pump. The piston and piston rod are hollow, the piston being made of considerable length, and its diameter being reduced at two or more places intermediate of its extremities, to allow any liquid which finds its way between it and the sides of the cylinder to be collected in the annular spaces left at such reduced places, and so prevent any injurious effect upon the working of the piston. The piston is used without packing being made, with the exception of the reduced places above mentioned, of a diameter sufficient to occupy the cylinder of the pump, and, at the same time, be capable of being moved freely up and down in it. The lower end of the piston is brought to a sharp edge by beveling its bottom on the inside, thereby making its bottom in its interior of a conical or funnel shape, the narrowest part forming the seat of the piston valve. S. Emilius Hewes, of Albany, N. Y., is the inventor.

Trace Buckles.—This invention consists in the use of a buckle frame hung by a centre cross bar within a loop of the inner end of the hame tug, the outer end of which frame has a swinging bar, bent into a circular shape or nearly so, and provided with a centre tongue or pin, which tongue, when the outer end of the trace tug has been drawn sufficiently through and under both ends of the frame, securely holds the same in position, by inserting it within the proper aperture thereof, and of the hame tug. H. S. Woodruff, of Janesville, Wis., is the inventor.

CHEMICAL NOTES.

METALLIC TITANIUM.—Within the past few months titanium metal is stated to have been obtained in considerable quantities in Birmingham, by reduction with sodium, the resulting powder being fused into compact masses of large size; the similarity of titanium and iron is striking. Little doubt is entertained that ere long the new metal will be produced at about the price of silver, in which case many practical applications could, probably, be found for it. The metal is largely disseminated in nature, so that once introduced a constant supply could be depended on.—*Mining Journal.*

PROCESS FOR RENDERING WOOD PLASTIC.—A very simple method of rendering wood plastic has recently been discovered. It consists in injecting diluted hydro-chloric acid into the wood under a pressure of about two atmospheres. The duration of the operation must be regulated by the nature of the wood, the bark is not removed, and by a very simple arrangement the liquid injected at one extremity may be partially collected at the other. If the green wood is submitted to pressure, the cellules having been previously washed with water, it may be reduced to a tenth of its original size; the fibres may be excessively compressed without breaking or tearing, and when dry have no tendency to resume their natural condition. Woods treated in this way will serve for many purposes. If after the treatment with hydrochloric acid the wood is washed and dried, it may be cut and chiselled with great facility, and serves admirably for sculptural purposes. The wood is dried by passing air under pressure through the cellules at about 3?°, the moisture is rapidly expelled, and as the mass contracts evenly throughout, there are no cracks. Colours or the various substances which prevent wood from rotting may be injected in a similar manner; soluble glass or freshly precipitated silica renders it very durable and at the same time incombustible.

THE PROPERTIES OF COLCHICINE.—In concluding a paper on this subject, Herr Hubler states that colchicine is really only poisonous to carnivorous animals, and that in proportion to its poisonous effects on these it is innocuous to herbivora.

A NEW ORGANIC PIGMENT.—A new colouring matter has been discovered by Herr Buchner. It is termed *rhamnoxanthine*, and is produced by the bark of *Rhamnus frangula*. The crystals have a brilliantly yellow colour, and may be found within the bark of the plant.

SACCHARIDE OF COD-LIVER OIL.—This substance, which, according to the recent analysis of Mr. Attfield, is simply sugar of milk, is stated by Dr. L Thierre (*Pharmaceutical Journal*, January) to be composed of sulphur, iodine of potassium, bromine, and hypophosphite of lime.

SULPHO-ARSENITE OF QUININE.—Signor Vincenzo Marietta thinks that the arseniate of quinine is too dangerous a medicine for general use, and he therefore proposes to substitute for it the above-named salt. The sulpho-arsenite may be safely administered in doses of from five to seven decigrammes. The salt is prepared by saturating an aqueous solution of arsenious acid with an alcoholic solution of tribasic sulphate of quinine, almost to neutralization; the solution is then evaporated, and the crystals are formed. Signor Marietta adminsters the new preparation with sugar, in the proportion of five decigrammes of the former to two grammes of the latter.

GLEANINGS FROM SCIENTIFIC WORKS.

IF the mountains of the Cordilleras were about one hundred times higher than they are the seas would, by their attraction, be elevated into liquid mountains on both sides of the coast of America, and the ports of France and Japan be left dry.

IF altitudes be taken from the earth's surface in arithmetical progression, the density of the air decreases in geometrical progression. Thus one cubic foot of air at the sea level would, at an elevation of 70 miles, occupy a space of 1,048,576 cubic feet.

A ROD of well seasoned and dried bay-wood three-eighths of an inch in diameter, and exposed to the tension of twenty-six pounds, gave an expansion of ·00000461 per degree cent, but when a weight of 4·6 pounds was hung to it, its co-efficient of expansion was increased to ·00000566.

FROM an investigation of the motion or direction of the flights of a cannon ball or shell fired in a northerly or southerly direction, it appears that a large shell will be subject to a deviation from the true line of projection, in consequence of the earth's rotation, amounting to no less than 22 feet.

THE first cotton manufacturing company organised on the Pacific coast have commenced operating a mill in San Francisco, with a paid up capital of 100,000 dols., and will commence manufacturing in November, with thirty-two looms, and thirty operatives. They will manufacture drills and standard sheeting.

THE power of conducting heat of a piece of dried chalk was equal to ·19, but became equal to ·30 when the substance was very moist. That of a well-dried piece of new red sandstone was equal to ·25, but became as much as ·60 when saturated. For a block of dry clay the conductive power was ·21, and became ·37 when well moistened.

THE height of Chimborazo is 1-1,017th of the radius of the earth; one of the mountains in the moon has been estimated at 1-219th of her radius; the highest in Venus is 1 14th; and one in Mercury is 1-126th. The highest mountains of the earth are in its southern hemisphere, which is also the case in respect of Mercury and Venus.

THE cohesive force of the best red sealing wax has been proved to be equal to 1,500 pound per square inch, and that of the black sealing wax rather more than 1,000 pound to the square inch; the deficiency in the latter is attributed to the diminished quantity of lac used in the composition. The cohesive force of solid glue was found to be 4,000 pound per square inch.

FERMENTED liquors and wines contain iodine, but milk is richer in that substance than wine. The proportion of iodine in milk is in the inverse ratio of the quantity yielded. Eggs also contain iodine, a fowl's egg, weighing 50 grains contains more iodine than a quart of cow's milk.

IN Russia corn is stored in pits dug in the soil, the sides of which are hardened by long exposure to fire. Before the grain is introduced straw is ignited in the pit to purify and dry the air. The grain is thrown in and packed close. It has been thus preserved forty years, it is said.

THE following is the exact result of an analysis made of glass discovered at Pompeii:—Silex 69·43, lime 7·24, soda 17·31, aluminium 3·55, oxide of iron 1·15, oxide of manganese 0·39, and a trace of oxide of copper in 100 parts. The glass of the present day has a very similar composition.

WERE the moon to fall into the sun it would develope an amount of heat sufficient to cover one or two years expenditure; and were our earth to fall into the sun a century's loss would be made good.

THE sound of the cannonading at Waterloo is said to have been heard at Dover, and the noise of a sea fight between the English and Dutch, in 1672, was heard at Shrewsbury, a distance of 200 miles.

AN asteroid falling into the sun, with a velocity of 39 miles a second, would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight.

THE first friction matches were introduced in 1832. In France and England alone 3 0,000 pounds of phosphorus are annually made into matches. Three pounds of this substance are sufficient to tip five or six millions of matches.

ABOUT one hundred years ago a house was built at Baltimore of bricks imported from England, while beneath the site of the building existed a bed of clay which afforded, and still affords, material for the manufacture of millions of bricks.

M COLLADON heard the sound of a bell struck under water across the whole breadth of the Lake of Geneva, a distance of nine miles; this sound appeared to pass through the water with a velocity of 4 708ft. per second.

THE first bridge over the Thames, at London, was of wood, and was built in the reign of Ethelred II., between the years 993 and 1016; in 1163 it was rebuilt of timber, and in 1176 the stone bridge was begun. Its original length was 940ft., height 44ft., and the clear width between the parapets 47ft.

ACCORDING to Newton, the great comet of 1680, at its perihelion, was only distant from the sun by the 163rd part of the semi-diameter of the earth's orbit, where it would be exposed to a heat above 2,000 times greater than that of red-hot iron, a temperature which would instantly dissipate any substance with which we are acquainted.

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LETTERS TO THE EDITOR.

We do not hold ourselves responsible for the opinions of our correspondents.]

SOLUTION.

Sir,—In your fourth number of the MIRROR OF SCIENCE, now incorporated with the ENGLISH MECHANIC, I observe an interesting inquiry from X. Y. Z., but the printers have omitted to give the formulæ referred to. With your permission I will remove the difficulties attending the omission, and at the same time give a solution to the question in general terms.

First, then, it must be understood that if a body is projected vertically upwards with any given velocity, the height ascended to will be as the square of that velocity till all motion is lost, and by the general laws of motion we have $v = \sqrt{2gs}$. Making use of this in the conditions of the question we obtain :—

$$2ga : a :: 2gae^2 : \frac{2gae^2 \times a}{2ga} = ae^2$$

a'so $2gae^2 : ae^2 :: 2gae^4 : \ldots\ldots = ae^4$

and $2gae^4 : ae^2 :: 2gae^6 : \ldots\ldots = ae^6$, &c.

from which it appears that the respective spaces described by the ball form an infinite decreasing equirational progression, the first term of which $= a + ae = a(1+e)$ the ratio being e^2, hence the sum of such series would be :—

$$(1) \quad a\left\{\frac{1+e^2}{1-e^2}\right\} = \text{space described.}$$

With regard to the time we have $t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2a+2ae^2}{g}}$, or

$$t = \left\{\frac{2a}{g}\right\}^{\frac{1}{2}}(1+e) \text{ in falling through the space of}$$

the first term, also $t = \left\{\frac{2a}{g}\right\}^{\frac{1}{2}} (e+e^2)$ in falling through the space of the second term, &c., ad. infin. Whence we have the first term of another infinite series, the ratio of which is e, and the sum of the series is readily found to be

$$(2) \quad \sqrt{\frac{2a}{g}}\left\{\frac{1+e}{1-e}\right\} \text{ the second formula given}$$

by Veritas in the *Family Herald*, as referred to by X. Y. Z.

I am very glad to see that a portion of your space has been devoted to mathematical enquiry, and I trust that the enlarged space at your disposal in consequence of the amalgamation of THE ENGLISH MECHANIC and the MIRROR OF SCIENCE will leave you sufficient room to discuss interesting questions in this peculiar science, the tendency of such questions (even though not immediately applicable to practical purposes) being to draw out and cultivate the highest faculties of the mind, those powers of reasoning which distinguish "man" from the brute creation. WM. TOMKES.

MR. HARRINGTON'S LECTURE ON THE CHEMISTRY OF NATURE.

Sir,—I have now the conclusion of Mr. Harrington's lecture before me, and, certainly, the arguments by which he supports his theory are quite as extraordinary as the theory itself. He asks, in the first place, why, during a solar eclipse, he does not perceive light flowing down round the moon, as it flows down round his hat or a shilling held up before the light. The answer to this is that light is flowing down past the moon, but cannot reach the eyes of those who stand in the central shadow, as light only travels straight lines. A person inside the shadow cannot see any in of the rays that pass the sides of the moon; for, as Mr. H. tells us, those rays are, when they reach the earth, 180 miles apart. In fact, in the next paragraph, he himself tells us that light does so pass down, for he says that all that portion of the earth turned towards the sun, is illuminated by his beams, with the exception of the comparatively small circle (189 miles in diameter) that the moon's shadow occupies, and how, I ask, could such beams reach the earth unless they passed round the body of the moon, which is exactly between the sun and the earth during every so ar eclipse? If Mr. H.'s range of vision was as large in proportion to the moon and its distance as it is to the hat and shilling and their distances, he would see the light flowing round the moon, and falling upon the earth almost exactly as he does in the latter case, the slight difference perceptible being caused by the refraction of our atmosphere. The account of Schuchmacher of the gilding of the eastern cloud when the sun's rays fell upon it is such a common appearance, and so easily explained, that it is almost a waste of time noticing it.

The next thing that Mr. H. finds impossible to account for by the old theory is, the fainness of the last rays of the sun before totality, while the first after his re-appearance are so bright as to be almost unbearable. If Mr. H. will try the following experiment he will perceive the cause of this appearance and, also, how easily the senses are deceived, and how little they are to be depended upon for an exact account of any natural phenomenon.

Let him on some bright sunny day carefully close up a room, so as to exclude all daylight, and then light up that room with some hundreds of candles. Now, if after being in the bright sunshine some time, he enter this room, the light the candles give will appear as faint, dim, and smoky as it can possibly be. But, if he enter this artificially lighted room after being in perfect darkness a short time, he will find the light to be quite dazzling, and for a little while so bright as to be painful to the eye; and yet we know that it is precisely the same in both cases, although the effect on our eyes is so very different. So much for the effect of contrast. Now, during the course of a solar eclipse, our eyes are placed under precisely the same conditions as in this experiment. We watch the bright sun appear smaller and smaller as the dark body of the moon moves across, and our eyes, contracted to the utmost by the refulgence of the unclouded sun, are intensely sensitive to the gradually increasing faintness of his light, until, at last, he entirely disappears, and the eye of the observer is enveloped in total darkness. During the time this continues, the pupil of the eye by a natural process becomes dilated to its utmost extent, so that when the first beams again fall upon it, the quantity of light that enters this dilated pupil is many times greater than could possibly enter just before totality because the pupil then was contracted by the broad daylight which a few minutes before it was exposed to. Now, as it is the quantity of light that falls upon the retina which gives to us our impression of the relative dimness or brightness of any object, it is very plain that, judging from the effect on the eye alone we must conclude that the sun is brighter at the finish of the eclipse than at its commencement, although such conclusion, as we perceive by the above experiment, is altogether erroneous.

Mr. H. says that it is impossible by the old theory to explain the fact of the moon during a total eclipse (lunar) being visible, and of a fiery red colour. I must beg to differ from him in this—nothing is more easy than to account for it, and when so explained, the manner of it, instead of being unaccountable, is intelligible to any one possessing the slightest knowledge of dioptrics.

Light in passing from a rare into a denser medium, is turned from its path to one more or less perpendicular to that path. As a rule, the denser the medium, the greater the angle the new path forms with the old one. Take a sphere of glass, hold it between the sun and a sheet of white paper, at a distance from the paper equal to ½ of its diameter. The rays from the sun in passing this, the sphere, are bent from their path, and, in consequence of the shape of the sphere, are all bent towards each other, so that they meet in a small bright spot which will be perceived on the paper. Take the sphere gradually farther and farther from the paper, and the spot will grow larger and fainter, a proof that the rays crossed at the point where the spot was smallest and are now diverging at the same rate they converged. Now take a hollow sphere, made of thick glass, fill the internal cavity with some opaque substance, and again hold it between the sun and the paper. The bright spot will be seen occupying precisely the same position as before, namely: opposite the centre of the globe; notwithstanding the fact of the opaque substance standing right between it and the sun. If the sphere be moved away from the paper, the spot will be found to behave precisely as before, the only difference being that it is fainter in consequence of a portion of the rays being stopped by the opaque substance. This is all we require to explain the phenomenon under consideration. Let the earth occupy the position of the central opaque core—the atmosphere that of the shell of the sphere—the paper that of the full moon, and the sun where he is, and we see at once that the air by its refractive power and its form (a sphere), combined, must refract all the rays passing through it towards some portion of space opposite to the sun. These rays, however, will not come to a focus at the same comparative distance as those through a glass sphere, owing to the refractive power of the air being much less than that of glass, and, in consequence of the air becoming less dense, the farther it is from the earth's centre, the focus will be prolonged indefinitely, as the less the refractive power of the sphere the longer is its focus. Thus, we see how simply is explained the fact of that space where the earth's shadow falls being filled with light. The reason the moon appears red is that the air only transmits the red and yellow rays, and as all the rays that fall on the moon have passed through the air, they are denuded of the blue rays, so that the moon could not possibly reflect any other light but red, she only being able to reflect such as she receives. J. M. MOSS.

SECONDARY BATTERY.

Sir,—In describing the first of these powerful batteries, I stated how one might be made from sheet lead only, but if in the place of one of the sheets of lead we substitute a sheet of amalgamated zinc, and connect the zinc of the primary battery to the zinc of the secondary battery, we shall obtain a very much more powerful current. The zinc in the secondary battery is not wasted away, for that which is dissolved away when the secondary battery is in operation is again re-deposited on the zinc by the action of the primary battery.

This is the form of the secondary battery that is to be worked with one cell of any battery through a primary coil of wire.

The primary coil of wire should be at least 120 feet long, and wound on a bundle of iron wires in the usual manner. A contact breaker must be attached to this to interrupt the current, as it is only the induced extra current that is used to charge the secondary battery.

To charge the secondary battery connect the zinc element of the secondary battery to the screw part of the contact breaker, and the lead element to the spring of the contact breaker

Now connect the zinc element of the primary battery to the binding screw which leads to the screw of the contact breaker, and the lead element to be connected with the spring of the contact breaker. Now set the coil in action, and in a very short time a powerful current may be obtained from the secondary battery. It is not necessary to disconnect the secondary battery from the coil when it is wished to be used, but it may be disconnected if required.

If I have not made the description so plain as I should have wished, I shall be happy to assist through your pages in the usual manner.

I have not entered into the rationale of these batteries, thinking a description would be sufficient.

"ANION."

RAINFALL.

Sir,—THE ENGLISH MECHANIC having amalgamated with the MIRROR OF SCIENCE will probably not be unwilling to have the reflection of a few meteorological facts from time to time. I now offer a few remarks upon rain. The years 1864 and 1865 are strikingly in contrast as regards the rainfall, in the British Isles at least. The results of my daily observations for these two years are as follows (the rain gauge being about 80 feet above the sea level, and two feet above the ground) :—

Month.	Total depth of rain in in.		Days of rain	
	1864	1865.	1864.	1865.
January	1·09	3·87	11	16
February	1·04	2·41	21	20
March	2·83	1·19	18	16
April	0·89	0·45	7	5
May	1·98	3·59	11	18
June	1·51	1·61	11	3
July	0·47	1·77	6	13
August	1·29	4·74	9	19
September	2·43	0·51	12	3
October	1·06	6·29	11	20
November	2·38	1·89	12	19
December	0·51	1·17	8	13
Total	17·47	29·49	137	165

The average yearly fall of rain in London is 25 inches. There was, therefore, a deficiency of 7½ inches of rain in 1864, and an excess of 4½ inches in 1865. The table clearly shows that a deficiency of rain was always followed by a very wet period, thus :—

Months of deficiency.		Months of excess.
Jan. and Feb.	followed by	March.
April	,,	May and June.
July and Aug.	,,	Sept.
Oct.	,,	Nov.
Dec.	,,	Jan. and Feb.
March and April.	,,	May.
June and July	,,	August.
Sept.	,,	Oct.
Nov. and Dec.	promise a wet	January, 1866.

For several years I have noticed that a period of drought is followed by a period of heavy rains. This result is worthy of the attention of agriculturists, and, indeed, was long ago brought to notice by Luke Howard in his work on the "Climate of London," in which he says :—"The important agricultural business of haymaking would probably derive considerable aid from the use of the barometer, and attention to its indications might preserve from spoiling much valuable fodder. It must be a subject of great satisfaction and confidence to the husbandman to know at the beginning of a summer, by the certain evidence of meteorological results on record, that the season, in the ordinary course of things, may be expected to be a dry and warm one, or to find in a certain period of it, that the average quantity of rain to be expected for the month has fallen. On the other hand, when there is reason, from the same source of information, to expect much rain, the man who has courage to begin his operations under an unfavourable sky, but with good ground to conclude, from the state of his instruments and his collateral knowledge, that a fair interval is approaching, may often be profiting by his observations, while his cautious neighbour who waited for the weather to settle may find that he has let the opportunity go by. This superiority, however, is attainable by a very moderate share of application to the subject; and, by the keeping of a plain diary of the barometer and rain gauge, with the hygrometer and vane under his daily notice."

A superabundance of rain is said to be injurious to the potato, the vine, and other plants. Not only does the irrigation of the land depend upon a certain amount of rain, but the navigation of rivers and canals and the water supply of towns are also dependent upon rainfall, and both droughts and floods are attended with disastrous consequences. The importance, then, of a knowlege of the mean annual fall of rain in particular localities, and of the average number of days on which it falls in the year must be evident. R. STRACHAN.

11, Offord-road, N.

PAPER TUBING.

Sir,—An Opera Glass Tube and Telescope Tube Maker would do well, I think, to forward his name and address to your excellent and widely-circulated journal, as I am very much disposed to assert (speaking from my own experience) that all amateurs of optics will find paper tubing very unsatisfactory when made. The best and most satisfactory telescope I can make is on the opera glass principle, viz., an object glass of small magnifying power, and a deep concave eyepiece, the only, but I must allow, considerable drawback being, for a single tube, a small field of view. PHILO-OPT.

A HINT TO BELL-HANGERS.

Sir,—The enclosed sketch of a boring brace may be useful to some of your readers if you can find room for it in a corner of your journal.

It was made by a bellhanger in my employ, and he uses it for boring holes in the joists for the bell wires to pass through. The bit C (a nosebit answers best) is placed

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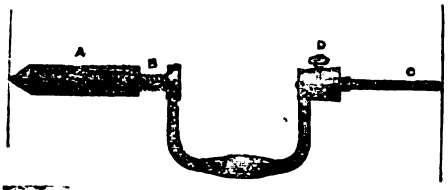
against the joist to be bored, the socket A held in the left hand, against the next joist. On turning the brace the screw B works out, forcing the bit through.



I have seen this tool in action and can confidently recommend it. I believe that at least three holes can be made with it in less time than one can be bored with a gimlet, and any smith can make it.

The extreme length, bit included (when the socket is screwed close up) is 12 inches that being the distance builders usually leave between the joists.

E. H.

Sir,—I send a rude sketch of a tool for cutting paste-board or paper for friction pulleys or paper bowls. It makes a better job and quicker one than cutting with gouge chisel and mallet, and it costs a mere trifle. It might be more used than it is.

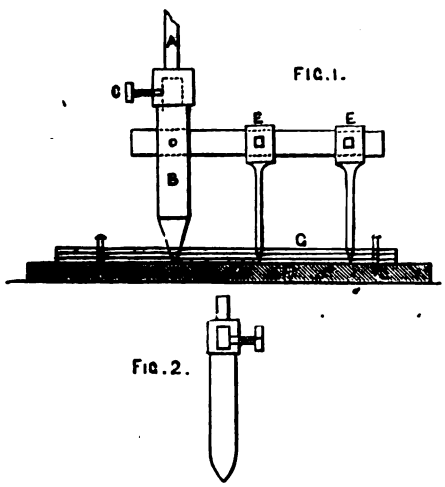


Fig. 1. A is part of the spindle of a vertical or drilling machine.

B, a centre tool with centre point and slot hole.

C, set screw in vertical spindle for holding drill bits.

D, set screw for holding bar, which passes through cutter hole of B to carry the two cutters E, E

E, E, two cutters set to any width or diameter of circle by means of set screws.

Fig. 2. Edge view of cutters E, E.

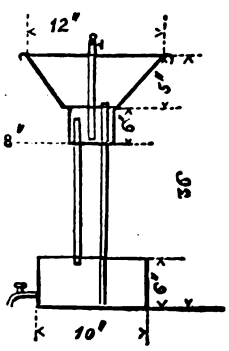
F is a board laid on vertical table to hold the paste-board or paper to be cut, so when the cutter passes through the paper it will not blunt the cutters.

G is the paper in square sheets, laid upon the board, and tacked at each corner with one nail, to prevent the paper from running round with the cutters.

The nails can easily be drawn with nippers or clawed tack hammer.

PAPER PULLEY.

Sir,—I have a sketch of a fountain in Vol. I of THE ENGLISH MECHANIC, No. 25, p 294, called Hero's. I made one—the result of my experience I give along with a sketch for the benefit of your readers:—



Height over all.

The tubes were ¾ of inch in bore, and a gas burner for jet. The height the water ascended to was 6" at most above jet, and only played for 7 minutes.

DISAPPOINTMENT.

OUR SUBSCRIBERS' NOTES AND QUERIES.

PRACTICAL MECHANICAL DRAWING.—Can any reader help me to the title of some good book, giving information about the drawing of threads, wheels (cogwheels), diagrams for locomotive engines, &c?—J. W. WILLEKES MACDONALD

PHOTOGRAPHIC.—Can any of your readers inform me how to fix photographic representations of leaves, &c, taken on paper prepared with bichromate of potash? I have tried dipping in solutions of hypo. of soda of various strengths, but the picture is dissolved thereby.—TYRO.

HORIZONTAL STEAM ENGINE.—Will some correspondent furnish me with drawings of a model horizontal steam engine, giving dimensions with figures or measurement with exact dimensions of slide valve and reversing motion?—T. H. B.

GAS METER.—Will any correspondent inform me of the best method of keeping water gas-meters in good working order, so as to indicate correctly the amount of gas consumed? Also by what means can I detect a meter working wrongly?—HENRY LEWIS.

LEYDEN JAR.—Will Momus inform me if it is feasible instead of tin-foil to coat a Leyden jar with copper by means of the electrotyping process? A few hints on this subject will be very acceptable to—ELECTRON.

SCALE IN STEAM BOILERS.—Will any correspondent inform me of a remedy for clearing the scale off steam boilers? Our boilers after working 4 weeks, are covered with a scale sometimes ¼in. thick, and it takes 8 men about 16 hours to chip it off with hammers I account for this unusual quantity of scale, from the water coming off chalk rock.—T E D.

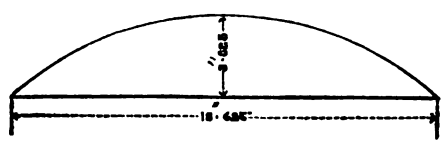
CRAMP.—Wanted, a description of a cramp or gibbet, to hold tin roller lengths or cylinders, while they are being soldered without pressing them out of shape—the cylinder to be 5in. in diameter by 13in. long, with a lap to solder of ¾in.—J.L.

BUNSEN'S BATTERY.—Can Mr. Tonkes, or any other scientific contributor, give the method of making "Carbon plates, or blocks, for Bunsen's batteries?" The proportions of coke, coal, and sugar, and the shaping the carbon after calcination.—CARBON.

STAIN AND POLISH.—Can any reader inform me of the best stain to imitate mahogany on deal? Also the best and cheapest way to make French polish, and the quantities required?—ARTIFICIAL AMATEUR.

BURNER.—Can any reader inform me if the burner in Pettit's gas and air heating stoves is a patent; and if so about the date of patent?—PARACELSUS.

DIAMETER OF A CIRCLE.—Will any reader oblige me by



giving the simplest method of arriving at the diameter of a circle, the size of an arc being given?—H T

THERMO-ELECTRIC MACHINE.—Can any of the readers of E. M. inform me how to make a very sensitive one?—J. SARGENT, JUN.

WHEEL TIRES.—Will any reader inform me if there is, and where, a machine for bevelling "tires" for waggon wheels, from 2 to 6in. wide, and ¾ thick?—A. SMITH.

SPONGE GOLD.—Can any correspondent inform me how sponge gold is prepared? One of the two samples I have seen is formed chiefly of octahedral crystals and indistinct fibres, the other is made up of beautiful foliaceous crystals resembling in appearance the froud of a common fern, lying together greatly entangled and interlocked. I shall also be glad if you can inform me which is the best work on hard and soft enamel painting? I have Weal's shilling book, which is not good for much.—PERIOSTEUM.

REPLIES TO QUERIES.

VELOCITY OF RIVERS.—In answer to Greenholme's inquiries as to the velocity of rivers, in your No. 42, vol, ii., 12th January, current.—It has been distinctly ascertained by actual observation that the velocity of a river may be found by the following rule:—Multiply the mean hydraulic depth of the river by the declivity (both in feet), and extract the square root of the product; the result diminished by one sixteenth part will be the mean velocity of the river in miles per hour. Thus, the Ganges, which has only a fall of 4 inches per mile, and a mean hydraulic depth of 30 feet, is about 3 miles per hour. (See Sir John Leslie's work on Natural Philosophy, page 423.)—JOHN KENNEDY.

PITCH OF THREAD.—Let "Slide Lathe," purchase for 1s. or 1s 6d., "The Fitter's and Turner's Pocket Book," by J. La Nicca, which will enable him to find any set of wheels for any pitch of thread or guide screw, published by E. and F. N. Spon, 16, Bucklersbury, London.—J. H. B.

GRINDING COLOURS.—John Langley will find that mills for grinding colours will also grind printer's ink, and are easily cleaned by running water through them for a few minutes after using. The best makers of the mills for such general purposes are Messrs. Whitmore and Sons, Engineer's St John-street, Clerkenwell, prices varying according to size.—DUSTY MILLER.

THERMO-ELECTRIC BATTERY.—This instrument used at the Royal Polytechnic Institution, was manufactured by me, and a similar one can be seen by J K. at my factory, 11 and 12, Beak-street, Regent-street, W.—S. C. TISLEY.

SOLDERING WATCH-CASES.—A correspondent who inquires about soldering watch cases, will find that the solder generally used is composed of silver 20 dwts, and of brass 8 dwts, well melted together.

WATER POWER.—If Scotch Mechanic will write to Mr. W. Cheetham, Grafton-street, Ashton-under-Lyne, he may receive information respecting the best Turbine or Water-Wheel extant.—M. ENGINEER.

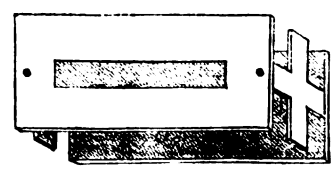
WATER-WHEEL.—If the Scottish Mechanic will send his address to Mr. J. Stewart, No. 8, Greenhill-street, Glasgow, he will communicate to him a devised plan of water-wheel.—J. S.

WATCH CASE JOINTS.—Watch Case desires to know how the joints of watch cases are put on. The cover is fitted on to the band, and when in its place a narrow file is put down between the two as deep as the joint is to lay, the cover and band are then separated sufficient to introduce a round file, which is the same size from end to end and the size of the intended joint; by pressing the two pieces together they are undercut, and this forms the bed for the hollow joint wire, the three pieces of which are secured with fine iron wire and soldered as described in the ENGLISH MECHANIC, vol. 2, p. 152.—E. PARR.

ELECTRIC COIL, &c.—I think the instrument required by "Student" is Wheatstone's "Rheostal" Measurements are obtained by attaching a coil of known resistance, and comparing it with the coil to be measured. A full description of it is given in "Noad's Manual of Electricity," which I would advise Student to purchase. A.P. will find everything he wants to know in "Hardwick's Photographic Chemistry." Thanks to "Young Idea." I think I have discovered the cause of the syphon action I mentioned in No. 39—E. H.

HINTS ON PHOTOGRAPHY.—Allow me to recommend your correspondent A. P to treat his bath by a method which appeared some time ago in the *Photographic News*; it is now much used and very efficient, viz,—Add by degrees a 10 grain solution of cyanide of potassium until the bath is rendered slightly turbid, a double decomposition takes place, the turbidity consists of cyanide of silver, and the liberated potassium combines with, and neutralizes any free nitric acid which may be present. Put the whole into a clear glass bottle and expose to bright sunlight for some hours. The organic matter will blacken and precipitate, and should be filtered out, and the solution will then be bright and clear, it will probably require a drop or two of very dilute nitric acid, but it is as well to try a plate first and see. After this treatment baths will often be found to work better than they did when new. With regard to his second query about making a new bath for instantaneous work, let me advise him to use the triple recrystallized nitrate of silver and to make the solution of 35, or for this cold weather 40 grains to the ounce. Neutralize by adding bi-carbonate of soda until a slight precipitate is formed. Sun and filter, iodize by immersing a large plate coated with collodion, and leaving it in 2 hours, then add the smallest quantity of dilute nitric acid that will suffice to make it work clean in the shadows. Use a good bromo iodized collodion and a rather strong iron developer, of say 30 grains to the ounce in winter, and about 20 in summer. I may add that it is useless attempting instantaneous pictures without a good and suitable lens. In recovering silver from photographic residues (does he not mean *Sulphide* instead of *Sulphate* of ammonia?) it should be added until there is no further precipitate, great care being taken not to add too much. For fuller information on all these subjects, I would recommend him to purchase the "Year-book of Photography" for 1866, published at the *Photographic News* Office, price 1s., which contains a summary of the art to its present state.—C. T. N.

DIFFERENTIAL GALVANOMETER.—For the further information of Student I beg to state that a *Differential Galvanometer* suitable for all general purposes may be made as follows:—Make a skeleton framework for the coil, consisting of two cheeks of dried beech wood bone, or other substance of equal size, cut an aperture in each of them corresponding to each other in position and size, fix a cross-shaped piece at each end and fasten all firmly together, thus:—



Then wind two silk covered wires simultaneously from one side to the other, and back again, till the frame is filled. In winding, to pass the centre uprights, cross the wires from one side of the centre to the other at the *bottom*, and so leave the upper opening quite free; this, whilst winding might be filled with a piece of wood made to fit, which could afterwards be removed. Between each layer a strip of sheet gutta percha, or foreign letter paper may be inserted. When the frame is full, the resistance of each coil should be measured by another galvanometer and resistances, and the two made equality adjustment. The coil should be then immersed for a little time in paraffin wax heated to a high temperature; on cooling the whole will form a solid mass and the wire will be highly insulated. Provide a base for the instrument, and three binding screws, or terminals, fix firmly the coil upon it, and join the inner end of one wire and the outer end of the other to the middle terminal, and the two remaining ends to the other two terminals. Construct a dial of card with a circle divided into 360 equal degrees, and in its centre cut a slot corresponding in length to the interior of the coil, and of sufficient width to admit of the needle passing through it freely. Then make this card a fixture to the coil frame. The needle and pointer must then be made thus; through an axle of bone, or other material, drill two holes parallel with each other, their distance apart being that between the centre of the coil and the dial, so as to admit the free movement of the whole when the magnetic needle is

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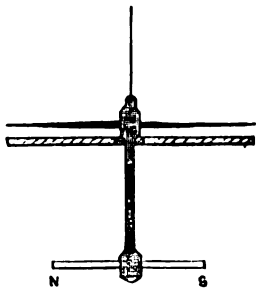
inserted in the lower, and the pointer (of bone aluminium or other light substance) in the upper one. A small hole in the axle above the pointer will serve to attach a single silk fibre, to suspend the whole by. The next step is to



erect an arch, of thick brass wire, firmly over the centre of the coil, from the centre of which suspend the silk fibre, when the needle and pointer should swing freely, the former being in the interior of the coil. For raising or lowering the needle a small thumbscrew might be added to the centre of the arch so as to wind up or unwind the fibre. For levelling the base three levelling screws would be an improvement. Cover the coil and dial with a glass shade to avoid the action of draught, or wind, upon the needle. An instrument of this description wound with No. 36 silk covered wire and containing from 600 to 1,000 turns would answer every ordinary purpose for which Student requires it. For out door use a more handy form would be desirable, but sensitiveness must, in a measure, be sacrificed. There are many units of resistance; the chief are Siemen's unit, Varley's unit, and the British Association unit, of the following relative values, viz. :—

26·3 Siemen's = 25·153 British Assn. = 1 Varley's unit

The first of these is *at present* the most universally adopted. I wish the ENGLISH MECHANIC a prosperous career and trust that it will not, like some scientific journals, die for the want of support.—MIRROR.

HYDRAULIC.—The quantity of water discharged from a pipe varies with the head of water according to the formula:—

$$Q = M S \sqrt{2 g H}.$$

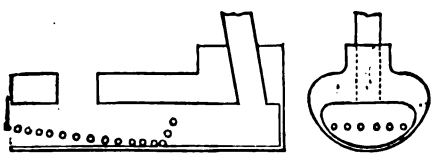
Q, volume of water discharged in one second.
S, area of the pipe.
M, coefficient of contraction = 0,62.
H, head of water corresponding to the pressure at the orifice of discharge.

The discharge is proportional to the square root of the head of water. For example, with 10 feet head, the discharge is 50 gallons; with 40 feet head, it will be—

$$\frac{50\sqrt{40}}{\sqrt{10}} = \frac{50 \times 6{,}325}{3{,}162} = 50 \times 2 = 100 \text{ gallons.}$$

H.

MODEL STEAM BOAT.—J. M. wishes to know the best form of boiler for a model boat. I have made two, the last one for a boat 40 inches long 5 inches beam, and 3 inches below the deck inside, and which drives a pair of oscillating cylinders, 1¼ inches diameter, 1½ stroke; paddle wheels 5 inches diameter, and two inches wide. A drawing will best show the form of boiler I used, which was 9 inches



long. I used charcoal supplied through the top door, as you cannot get at the other when the boiler is in the boat, and the draught is assisted by turning the waste steam up the chimney. I have tried a spirit lamp, but the spirit soon gets hot and takes fire, endangering the boiler and boat; charcoal requires more attention, but in my opinion is the best source of heat. Can any reader tell me how to supply the boiler with water? I have tried pumps, but they do not answer.—E. PARR.

VELOCIPEDE.—Having read the letters of Messrs. Walton and Phillips in Nos. 40 and 42, it gives me pleasure to write a concise description of a velocipede I had in Rochdale, some 6 or 7 years ago. It was as lightly, yet as firmly made as possible. The bearers were of lance wood bent to the required shape; mounted on these was a board with basket work attached for a seat. It was propelled by a lever standing up between the rider's legs. A light iron connecting rod jointed at the bottom end of this, worked a double crank on the main shaft, which was fixed to ordinary bow-springs under the seat. On and near the ends of this shaft were two fixed ratchet wheels, covered by strong hoops, on and projecting from the inside of the naves of the wheels. These hoops projected over the ratchets to protect them as well as to simplify the manner of holding the spring catches running in the ratchets. To prevent the carriage over-running the crank down hill, I fixed a light iron shaft behind the seat with a wooden break at each end, also a handle to the left hand to press down the breaks upon the driving wheels. These were two smaller wheels in front, which I could swivel with my feet and guide the velocipede. In all contests it was most satisfactory; owing, I believe, to the following arrangements:—

1st. The lightness and firmness.

2nd. Having four wheels, which made the carriage run steadier than three wheels would.

3rd. To the ratchet wheels on the crank shaft enabling the carriage to turn quickly.

I would have enclosed a drawing, but having already occupied so much valuable space I trust this description will be found sufficiently clear.—JNO. FIELDEN.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

JOHN INGHAM.—Purchase "The Principles and Practice of Photography," by Julez Hughes, 379, Oxford-street.

E. B. TRUEMAN.—We have published two or three descriptions of steam hammers. An illustration will shortly appear.

G. S. C.—We consider the work published by Spon to be a very sound one. If you visit the stamping department of the General Post-office, you will see that your invention is but little wanted there. The work is got through with marvellous speed.

TEN MILES AN HOUR.—Not charged for in the neighbourhood of London, but we have heard that in Cambridge and other counties they are charged as a one-horse vehicle.

X. Y. Z.—A quarter's notice.

SOCRATES.—1. We should advise you to obtain a provisional patent, which will secure you for six months; during that time you may be able to sell your invention to some of the large pianoforte or musical instrument makers. 2. Although useful, we do not think that the railway would take the invention up.

D. G.—In a few weeks.

CHEMICUS.—Unless you have interest with the authorities at the Admiralty, your chance of success is but small. A patent would never pay.

HENRY LOWE.—St. Helen's.

APPRENTICE.—Write again and explain the purpose you require it for.

CALLUM PAIS.—Can you favour us with the names of the newsagents in the town, and also of the addresses of one or two of the large workshops?

G. B. WILLIAMSON.—You are rather severe, but we thank you for the correction.

J. ROBERTSON.—Spon, of Bucklersbury.

PARACELSUS.—We shall be glad to receive the essay.

KEIGHLEY.—Thanks, but answered already.

G. WATSON, ED.—Being out of employment you can insert an advertisement in the ENGLISH MECHANIC for a shilling. Your case is a hard one, but unfortunately, there are thousands in a similar position.

F. MASON (Manchester).—Yes, decidedly.

WILLIAM WATSON.—It is a French patent, but you can obtain information by writing to the office of the Commissioners of Patents, Southampton-buildings, Chancery-lane.

R. BICTS.—Received.

SUB SPE.—Of Spon, Bucklersbury, or Atchley and Co., 106, Great Russell Street, Bedford Square.

A LONDON FIREMAN.—We expect to illustrate the subject shortly.

J. F.—We shall be glad to receive the drawing of the slide valve.

H. SHEPPARD.—The drawing was forwarded by a correspondent in the provinces, whose address we have mislaid.

A. LEE.—Received.

P. R.—Yes.

F. ROUSSEL.—The pitch is reckoned on the diameter of the wheel in place of the circumference, and distinguished as wheels of 8 pitch, 12 pitch, &c. Then, to find the number of teeth that a wheel of 16in. diameter, will contain of a 10 pitch:—16 × 10 = 160 teeth, and the circular pitch = ·314in. The diameter of a wheel for a 9 pitch of

$$126 = \frac{126}{9} = 14\text{in. diameter.}$$

F. REARDON.—The following has been recommended as a good gold varnish: turmeric, 1 drachm; gamboge, 1 drachm; oil of turpentine, 2 pints; shellac, 5oz.; sandarac, 5oz.; dragon's blood, 7 drachms; thin mastic varnish, 8oz. Digest in a warm place, for a fortnight, with an occasional shaking; set aside then to fine, and pour off clear.

A. JENNINGS.—We think this will do for you:—If d be the diameter of a pipe in feet, and D the discharge in cubic feet per minute, then for long straight pipes we shall have for velocities of nearly 3ft. per second, D = 2,400 $(d^5 s)^{\frac{1}{2}}$, and $d = \cdot 044 \left\{ \frac{D^2}{s} \right\}^{1\cdot 5}$; or if D be the discharge per second, D = 40 $(d^5 s)^{\frac{1}{2}}$, and $d = \cdot 228 \left\{ \frac{D^2}{s} \right\}^{1\cdot 5}$.

G. GORDON.—To calculate the strength of shafts, multiply the horse's power by the assumed number (300), and divide the product by the revolutions per minute; the cube root of the quotient will be the diameter required.

W. S. PAISLEY.—We consider the apparatus a very good one; but £5 5s. is not a very high figure, and, the more you are inclined to pay the better the article Mr. Cox can supply you with.

G. B. BUNNEY.—P. A. Roques, 51, High Holborn; but French publications can only be obtained by paying six months' subscription in advance.

*** We have to ask our correspondents to so sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well-Wisher," &c.

THE MECHANICS' EMPLOYMENT LIST.

SITUATIONS VACANT.

JOURNEYMEN COACHMAKERS.—Constant situations at the Biggleswade Carriage Works.

ORGAN METAL PIPE MAKER.—Apply by letter to Thomas C. Lewis, 21, Grove-road, North Brixton.

CABINETMAKER.—Apply to Mr. J. D. Reid, Upholsterer, Alton, Hants.

GASFITTER and BELLHANGER.—An experienced HAND, as above.—Apply to B. Giles, Ironmonger and Gasfitter, Eltham, London, S.E.

GASFITTER, Locksmith, Bellhanger, &c.—Apply personally, at Mr. Davis's, 87, York-street, Westminster.

TINMAN and BRAZIER.—A thorough good HAND.—Apply to A. Williams, Ironmonger, Hammersmith gate.

PAPERSTAINER.—An Active Young Man, as CLERK and COLLECTOR.—Apply at Scott & Co's, Whitelands, Chelsea, S.W.

A YOUTH, fond of mechanics, can be received on moderate terms into the family of a practical Dentist.—Apply to A. B. C., Messrs. Lemale & Co., Chandos-street, Covent-garden, London.

SHOEING SMITH.—Must be a good fireman.—Apply to Thomas Noakes, St. Michael's, Hastings.

A First-rate MAN to work a Wood planing Machine and a Moulding Machine.—Apply to Messrs. Samuel Wossam & Co., Saw Mill Engineers, King's-road, Chelsea.

JOURNEYMAN WATCH and CLOCK MAKER.—A steady, industrious YOUNG MAN.—Apply to H. Stedman, Jeweller, &c., Godalming.

DRUGGISTS' ASSISTANT.—A DISPENSING ASSISTANT for a Surgeon's, retail.—Apply at 100, Kennington Park-road.

GLASS PAINTER.—A Good GENERAL WORKMAN.—Apply to Alfred Beer, Bartholomew-yard, Exeter.

IRONMONGERS' ASSISTANT.—Apply at Chapman's Birmingham House, Gloucester.

FORRIL BINDER.—Apply at C. W. Whiten's, 10, John-street, Southwark-street, Blackfriars-road.

A Highly Competent MANAGER of Hematite Furnaces, Bessemer Steel Works and Rolling Mills.—Address, J. Harris, Woodside, Darlington.

Practical Mechanical DRAUGHTSMAN, accustomed to Tool work.—Address, to Messrs. Neilson Brothers, Albert Works, Glasgow.

A FOREMAN, to Superintend the Fitting Department of an Agricultural Implement Works.—Applications to Pickley, Sims, and Co., Limited, Leigh, Lancashire.

PRIME-COST CLERK in a Manufacturing Establishment.—Apply to Y. Z., No. 12, London-wall, E.C.

In a Builder's Office, a JUNIOR CLERK.—Apply to H. I. J., 13, Aldersgate Buildings, Aldersgate Street, E.C.

ARCHITECTURAL MODELLER and STONECARVER.—Apply to Mr. Fredk. Ransome, 2, Queen's Street, Place, Southwark Bridge, E.C.

SURVEYOR and DRAUGHTSMAN.—Apply to Harrison and D'Hooghe, 85, Northgate, Darlington.

ARCHITECTURAL MODELLER.—Apply to Herbert, 242, Euston Road, N.W.

DRAUGHTSMAN, on Engineering Establishment.—Apply to A. B. C., Mr. Miller's, 225, Westminster bridge Road, Lambeth, S.

MOULDERS, a Few Good Steady Foundry Hands.—Apply to R. Brotherhood, Railway Works, Chippenham, Wilts.

FITTERS, TURNERS, PATTERN-MAKERS, SMITHS and MOULDERS, wanted.—Apply to Ingram Phillips, Engineers, Fordingbridge, Hants.

A Thoroughly Competent BUILDER'S CLERK and ACCOUNTANT.—Apply to T. W., office of "The Builder."

In the Office of a Surveyor, a JUNIOR ASSISTANT.—Apply, stating references and salary required, to L. G., care of Davies and Co., Advertising Agents, Finch-lane, Cornhill.

A Good General GLASS PAINTER.—Apply to Alfred Beer, Bartholomew-yard, Exeter.

CLERK OF WORKS.—Address, to Mr. Charles J. Shoppee, 61, Doughty-street, London, W.C.

JOINER, as WORKING SHOP FOREMAN.—Apply to A. Z., Gibbons and White, Ironmongers, 345, Oxford-Street, W.

STONEMASONS wanted at Braintree Church, Essex.

CLERK of WORKS.—Address, A. B. C., care of Messrs. Harding and Wilkinson, Commercial Chambers, 33, Gracechurch Street, E.C.

Two or Three FITTERS and TURNERS, and a first-class MOULDER, accustomed to iron and brass.—Address, to Brown and Lock, Smithfield Ironworks, Shrewsbury.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

61. William Stuart Guinness, 42, Cheapside, London, improvements in sewing machines.
62. Edmund Perre, Manchester, certain improvements in the method of obtaining motive power and in apparatus connected therewith.

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66. James Skinner, Glasgow, an improved mode of preparing albumenized paper and the process connected therewith.
67. James Marius Macrum, 36, Hill-street, Knightsbridge, improvements in breaks for railway and tramway carriages.—A communication.
68. William Dakin Grimshaw, Birmingham, an improved wrench and cutter.
70. James Marius Macrum, Hill-street, Knightsbridge, improvements in the apparatus for distilling oils and other liquids.—A communication.
71. William Allen Turner, Clarges-street, improvements in machinery or apparatus worked by water for raising, lifting, lowering, and drawing goods of every description.
74. John Sadler, Birmingham, an improved nail and brad cutting machine.
76. Robert Shaw, Blantyre, Lanark, improvements in apparatus for regulating temperature, and for actuating timekeepers
83. Richard Archibald Brooman, 166, Fleet-street, improvements in the manufacture and purification of lamp black, and in apparatus employed therein.—A communication.
85. Richard Archibald Brooman, 166, Fleet-street, an improved method of producing oxygen.—A communication.
91. Percival Ashton Batchelor, 34, Upper Berkeley-street, Portman-square, improvements in the construction, arrangement and application of retorts and settings, in combination with machinery or apparatus for the manufacture of coal and other gases.
94. Charles Bartholomew, Doncaster, improvements in apparatus used in getting coal.
97. Charles Crump, Yealmpton, Devon, improvements in the preparation of tetra-chloride of carbon.
102. William John Walsh, Brentwood, improvements in cocks, taps, and valves.
103. Josiah Timmis Smith, Barrow-in Furness, improvements in moulds for casting the tyres of railway wheels.
110. John Calvin Thompson, 14, Burney-street, Greenwich, improvements in means or apparatus employed in the combustion of gas in gas stoves and burners employed in heating and cooking.
112. Hector Auguste Dufrene, 4, South-street, Finsbury, an improved machine for pressing bricks.—A communication.
121. Brereton Todd, 4, Victoria-terrace, Newcastle upon-Tyne improvements in the manufacture of arsenic.
122. Cuthbert Greenwood Johnson, Stockton, improvements in machinery for making bricks, tiles, and similar articles.
130. John Hooker, Walton-on-Thames, improvements in the manufacture of ammoniacal and ammoniated soap.
132. Albert Francis Johnson, Massachusetts, United States, improvements having reference to machinery for sewing.
135. Henry Edward Newton, 66, Chancery-lane, improvements applicable to water-closets and commode pans.—A communication.
136. Alfred Vincent Newton, 66, Chancery-lane, improvements in the construction of electric clocks.—A communication.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

PROPERTY RECORD.

AT THE GUILDHALL COFFEE-HOUSE.

BY MR. WHITTINGHAM.

Freehold, two residences, situate in Chesnut Grove, Malden, and a plot of building land, close to Malden station—sold for £720.

Freehold, two plots of building land, situate in Denmark-road, Camberwell—sold for £380

Freehold building land, having frontages to Hoe-street and Granville-road, Walthamstow—sold from £153 to £153 per plot.

Freehold building land, having frontages to Harringay road, Hornsey—sold from £55 to £120 per plot.

BY MR. MURRELL.

Freehold, two residences, being Nos. 29 and 27, Rye-lane, Peckham—sold for £2,210.

Leasehold house, being No. 2, South Wharf-road, Paddington let at £80 per annum, term 97 years, from 1824, at £4 per annum—sold for £265.

Freehold ground rent of £8 8s. per annum, secured upon No. 129, Barnsbury road—sold for £210.

Ditto, ditto on No. 131—sold for £210.

Ditto, ditto on No. 133—sold for £210.

Ditto of £16 16s., on Nos 135 and 137—sold for £420.

Ditto of £8 8s., on No. 139—sold for £210.

Ditto, ditto on No. 141—sold for £210.

Leasehold house, being No. 8, Penn-road Villas, Caledonian-road, let at £48 per annum term 90 years from 1852, at £8 per annum—sold for £475.

Leasehold, two residences, being Nos 213 and 215, Copenhagen-street, Islington, let at £20 each per annum, term 96 years from 1844, at £12 per annum sold for £770.

COMPETITIONS OPEN.

The Committee appointed to select plans for a new Church intended to be erected in the Humberstone Road, Leicester, are empowered to offer Premiums for the three best designs, viz., one of £25 and two of £10 each. A lithographed plan of the site, together with printed instructions and conditions, for the guidance of intending competitors, may be had on application to W. Fry, New Walk, Leicester.

Designs and Plans are invited for the erection of a new Workhouse at Upper Holloway, in the parish of St. Mary's, Islington.

Plans and sections of the ground, and full particulars and information that may be required, can be had on application at the Parochial Offices, Islington, William Hicks, Clerk.

The Town Council of the Borough of Rochdale are desirous of receiving Designs for Public Baths and other offices in connection therewith. Two premiums are offered, one of £30 for the design which shall be selected as best, and one of £20 for the design which shall be considered second best. Plans of the site may be obtained on application to the Town Clerk, Packer Street, Rochdale.

TENDERS SENT IN FOR BUILDING WORKS.

For rebuilding No. 101, High Street, Shoreditch, Mr. Mansell, architect:—Williamson (accepted) £795.

For restoration of Howard Chapel, Bedford, Mr. Usher, architect:—Wain and Foster, £515.

For new bridge, sluices, &c., at Kunston Park, Mr. Usher, architect:—Dickens, £335.

For new sunday schools, class rooms, minister's vestry, kitchen, &c., Bedford, Mr. Usher, architect.—Day, £2,140; Curwin, £2 119; Wain and Foster, £2,050.

For new shops at Rugeley, Messrs. Scrivener and Son, architects:—Barlow (accepted), £2,187.

For alterations and additions to the European Bank, 83, King William Street, City, Mr. Thomas Allason, architect:—Hill and Sons, £2,114; Henshaw, £1,538; Thorne and Co., £1,200.

For rebuilding Aylsham Vicarage, Norfolk, Mr. R. M. Phipson, architect:—Cornish (accepted), £1,310.

For restoring the chancel of Thornden Church, Suffolk Mr, R. M. Phipson, architect;—Grimwood and Vine (accepted), £573 10s.

For restoring Burgate Church, Suffolk:—Bishop (accepted), £650.

For proposed mansion and stabling, near Wavertree Mr. William Paice, architect:— Howell (accepted), £5 120.

For the erection of two villas, Acton, Messrs. Osborn and Russell, architects:—Webb and Sons, £910; Bird, £779; Lord, £770; Eydmann, £730.

For additions to manufactory, for Messrs. J. and G. Meakin, Hanley, Staffordshire, Messrs. Scrivener and Son, architects:—Barlow (accepted), £2,260.

For tavern and two houses, Shoreditch, Mr. J. Livock, architect:—Watts, £3,963; Conder, £3,771; Manley and Rogers, £3,710; Wells, 3,690; Scrivener and White, £3,588; Adamson and Son, £3,555.

For rebuilding warehouse, Houndsditch, Mr. H. Collins, architect: Cohen, £10,654; Hardiman and Sandon, £9 098; Colls and Sons, £8,972; Hill and Keddel, £8,884; King and Sons, £8,560; Conder, £8,445; Newmann and Mann, £8 391.

For restoring Cockley Cley Church, Norfolk, Mr. R. M. Phipson, architect:—Burrell (accepted), £1,352.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Alterations at the Union Workhouse, Stamford.—Particulars of Edward Browning Esq., Architect, Stamford.

Sinking a well at Upper Holloway to produce about 80,000 gallons of water per day, and for supplying and fixing the regular pumps.—Particulars of William Hicks, Esq., Parochial-office, Liverpool-road, N.

Erection of a Coast Guard Station at St. Andrew's, in the County of Fife.—Particulars at the Admiralty, Coast Guard-office.

Repair and maintenance of roads for the Exeter Turnpike Trust.—Particulars of Mr. Howard, Surveyor, 4, York-buildings, Exeter.

Erection of New Church, Parsonage and Schools at Bradley, near Bilston. Particulars of Martin Baldwin, Esq., Bilston.

Erection of Bacon Curing Works, &c., Cirencester.—Particulars of Mr. Cilsold, Russell-street, Stroud.

Rails for the Dutch Rhenish Railway.—Particulars can be obtained by Mr. C. J. Adams, 40, Gracechurch-street, London.

Masonry and other Works for the erection of a deep water quay wall, 190 yards in length at the North Shore, Newcastle-upon-Tyne.—Particulars at the Borough Engineer's-office, Town Hall, Newcastle-upon-Tyne.

The completion of the Pier and Floating Stage at New Brighton, and the construction of a Bridge to unite the same.—Particulars of H. A. Ewer, Public-office, Egremont, near Birkenhead.

Works necessary for the Deepening and Widening a portion of the river Witham, and for raising and strengthening the banks thereof.—Particulars at the Witham-office, Boston.

Construction of a Lighthouse Lantern for Castle Island, Bahamas.—Particulars at Trinity-House, London, E.C.

Supply and delivery of a Steam Engine, with boilers piping, &c., for the East Indian Railway Company.—Particulars of D. J. Noad, Esq., East India Railway-house, Aldermen's-walk, New Broad-street.

MEETINGS FOR THE WEEK.

TUES....Medical and Chirurgical, 8½.
Civil Engineers, 8. Continued Discussion upon Mr. Grant's Paper, "On the Strength of Cement;" and (time permitting) Mr. W. H. Mills, "On the Craigellachie Viaduct."
Zoological, 8½.
Ethnological, 8. 1. Sir E. W. Belcher, "Remarks on the Andaman Islands, from the Notes of Lieut. St. John." 2. Dr. Caddy, "Visit to the Patagonians."
Royal Inst., 3. Professor Tyndall, "On Heat."

WED....Society of Arts, 8. Lord Henry G. Lennox, M.P., "On the Uses of National Museums to Local Institutions."
Geological, 8. 1. Mr. R. A. C. Godwin-Austen, "Notes on Belgian Geology." 2. Mr. W. T. Locke Travers, "On the Origin of certain Lake-basins in New Zealand." Communicated by Sir C. Lyell, Bart.
R. Society of Literature, 8½.
Archæological Assoc., 8½.

THURS..Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Royal Inst., 3. Prof. Tyndall, "On Heat."

FRI....Royal Inst., 8. Mr. S. W. Baker, "On the Sources of the Nile."

SAT.....Royal Inst., 3. Prof. Westmacott, R.A., "On Art Education, and how Works of Art should be viewed."

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	101	0	0	0	0	0
Best Selected	do	104	0	0	0	0	0
Sheet	do	106	0	0	0	0	0
Bottoms	do	101	0	0	0	0	0
Australian	do	102	0	0	0	0	0
Yellow metal	per lb.	0	0	8½	0	0	9¼
IRON.							
Pig in Scotland	per ton.	3	9	0	cash.		
Welsh Bars, in London	do	7	15	0	8	0	0
Wales	do	7	0	0	7	5	0
Staffordshire	do	8	15	0	—		
Sheets, single in London	do	10	15	0	—		
Hoops, first quality	do	9	15	0	—		
Nail Rods	do	8	15	0	—		
LEAD.							
Pig, Foreign	per ton	20	12	6	21	0	0
Sheet, milled	do	22	5	0	22	10	0
Red or minium	do	22	10	0	—		
White, dry	do	29	5	0	—		
" ground in oil	do	28	0	0	29	0	0
Litharge (W.B)	do	24	15	0	25	0	0
Quicksilver	per bottle	7	18	6	8	0	0
Spelter, Silesian	per ton	23	0	0	23	10	0
English sheet	do	28	0	0	29	0	0
White zinc, powder	do	—			—		
STEEL							
Swedish faggot	per ton	16	0	0	—		
" Kegs	do	15	0	0	—		
TIN.							
Banca	per cwt	94	0	0	0	0	0
Straits, fine, cash	do	91	10	0	92	0	0
English Block	per ton	102	0	0	—		
" Bars	do	103	0	0	—		
" refined	do	105	0	0	—		

PRICES CURRENT OF TIMBER.

Per load—	£ s.	£ s.		£ s.	£ s.
Teak	11 10	12 10	2nd do	12 10	14 0
Quebec, red pn.	3 5	4 15	St. Petersburg yel.	10 10	12 0
yellow pine	—	—	Finland	8 0	10 0
Memel	0 0	0 0	Memel	0 0	0 0
elm	3 10	5 0	Christiania per C. 12 ft. by 3 by 9 in. yellow	18 0	23 0
Dantzic oak	3 10	6 0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0 14	1 6
fir	2 5	3 10	Staves, per standard M.		
Memel fir	3 0	3 10	Quebec, pipe	80 0	85 0
Riga	3 5	3 10	puncheon	20 0	25 0
Swedish	2 0	2 10	Baltic crown pipe	170 0	190 0
Masts, Quebec, rd. pine	6 10	8 10			
yellow pine	5 0	6 0			
red pine	0 0	0 0			
Lathwood, Dantzic	5 10	6 10			
St. Peter's	7 0	8 0			
Yellow Pine, per reduced C.					
Canada, 1st qual.	17 0	19 10			

MISCELLANEOUS.

	£ s.	£ s.		s.	£ s.
PUMICE STONE per tun	5 0	8 0	Olive, Gallipoli	56 0	0 0
OILS, &c.			Cocoanut, Coch. tun	52 0	52 10
Seal, pale pr. tun	50 0	0 0	Palm, fine	44 10	0 0
Sperm body	115 0	117 0	Linseed	37 10	0 0
Cod	53 0	0 0	Rapeseed, Eng. pale	56 0	7 0
Whale, 8th Sea pale	48 0	50 0	Cottonseed	36 0	42 10

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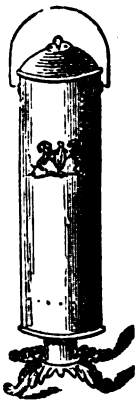

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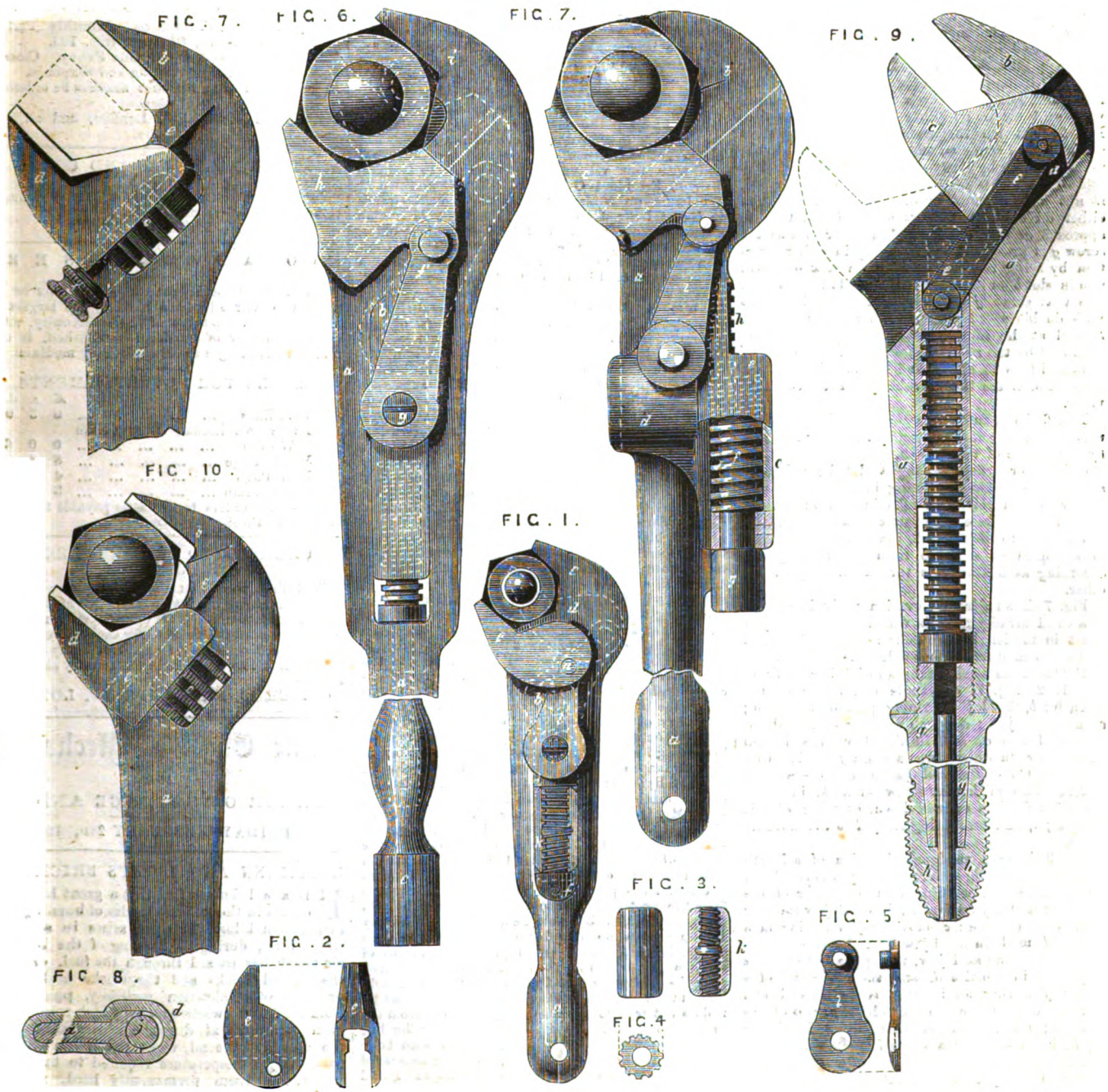
A JOURNAL DEVOTED TO THE INTERESTS OF ALL CONNECTED WITH ENGINEERING, BUILDING, NEW INVENTIONS, MANUFACTURES, METALS, PHOTOGRAPHY, CHEMISTRY, TELEGRAPHY, ASTRONOMY, ELECTRICITY, &c.

VOL. II.—No. 45.] FRIDAY, FEBRUARY 2, 1866. [PRICE TWOPENCE.



IMPROVEMENTS IN SHIFTING WRENCHES BY P. A. SAMUEL, OF PARIS.

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SHIFTING WRENCHES.

Illustrated on front page.

THE invention we are about to describe, illustrated by the accompanying figures, relates to improvements in screw wrenches in which the movable jaw is brought up to the fixed jaw by the action of a link or links, connected either to the handle or at a suitable point inside the handle. The inventor is Mr. P. A. Samuel, of Paris, and the patent has been taken out here by Mr. Clark, of Chancery-lane. Fig. 1 shows a wrench actuated by two links; Fig. 2, detached front and side views of the movable jaw; Fig. 3, side view and section of the nut or socket grooved on the exterior for actuating the movable jaw; Fig. 4, plan of same; lastly, Fig. 5 shows detached front and side views of one of the links. The same letters serve for all the Figures.

a, handle of the wrench having a long slot *b*, and terminated by a fixed jaw *c* of a piece with same; *d*, inclined edge forming a surface against which the movable jaw *e*, Fig. 2, closes; *f*, forked end of screw *g*, rivetted at *h* to the handle *a* at the bottom of slot *b*; *i*, slide running freely up and down in slot *b*, and having at its lower part a screw *j*, threaded inversely to screw *g*. The two screws *g* and *j* are placed in slot *b* one above the other; *k*, Figs. 3 and 4, nut for working screws *g* and *j*, being furnished for this purpose with a right and left hand screw thread corresponding with said screws; *l*, links shown separately at Fig. 5, jointed at the one end to the sliding piece *i* by means of screw *m*, and at the other end to the movable jaw *e* by pins *n*, with rivet heads fixed to said links. The whole being arranged as described, if nut *k* be rotated by the finger and thumb in either direction the screws *g* and *j* will tend to approach or separate from each other, but as the screw *g* is prevented from moving in either direction by being rivetted at *h*, the nut *k* only will rise in slot *b* on its being rotated. It results from this that screw *j* will rise and descend in slot *b* with double speed derived from screw *g* and nut *k*, and at the same time have an equal motion produced by the rotation of said nut. The slide *i* rises and falls in slot *b*, and by the aid of links *l*, *l*, opens or closes the movable jaw *e* on the fixed jaw *c*.

Fig. 6 shows another arrangement in which the movable jaw is set in motion by two links actuated by the handle of the wrench.

a, body or frame having a slot *b*; *c*, handle actuating a screw *d*, turning in the interior of a part *e*, which rises and falls in slot *b*; *f*, links jointed at the one end to part *c* by a screw *g*, and at the other to the movable jaw *h*, which is caused to approach or separate from the fixed jaw *i* according as handle *c* is turned one way or the other.

Fig. 7 shows a front elevation parly in section of a third arrangement in which the movable jaw is set in motion by two links regulated by a nut and screw mounted on one side of the handle.

Fig. 8 shows a sectional plan of this wrench on line 1, 2, Fig. 7, *a*, handle and frame of the wrench; *b*, fixed jaw forming part of handle *a*; *c*, movable jaw; *d*, strap working up and down on the frame *a*, and furnished with a lateral extension *e*, in which turns a screw *f* regulated by a nut *g*. On one side of the frame of the wrench is formed a semicircular screw thread *h*, in which the screw *f* works up and down, carrying with it strap *d*; *i*, link connecting strap *d* to the movable jaw *e*.

Fig. 9 shows a sectional elevation of a fourth arrangement, in which the movable jaw is regulated by a single link working in the interior of the wrench; *a*, body or frame; *b*, fixed jaw forming part of the frame *a*; *c*, movable jaw sliding in a groove *d*, made in fixed jaw *b* for the reception of link *e*, actuating said jaw, the upper end of link *e* is jointed in mortise *d*, and the lower end of a socket *f* having an internal screw thread and working up and down in the hollow part *a* of the wrench; *g*, handle of the wrench screwed to frame *a*; *h*, knob working a screw *i*, for effecting the rise and descent of socket *f*, whereby the movable jaw *c* is brought towards or separated from the fixed jaw *b*.

Fig. 10 shows a modification of the means employed for producing the motion of the movable jaw on the inclined edge of the fixed jaw. *a*, handle, having a fixed jaw *b*, and carrying an endless screw *c*; *d*, movable jaw mounted on the incline *e*, the two cheeks gearing with the endless screw *c* for the purpose of opening or closing the movable jaw by means of the latter. The endless screw *c* is grooved or roughened in order that it may be readily turned with the fingers.

Lastly, Fig. 11 shows a modified arrangement of the wrench last mentioned, according to which the grooving or roughened surface of screw *c* is dispensed with, and a knob *f* is fixed on its axis at back of the wrench, whereby to turn it as desired.

RENDERING GUNPOWDER NON-EXPLOSIVE.—It appears that amongst the many entitled to priority in the invention for protecting gunpowder, on the principle adopted by Mr. Gale and several other patentees, is Lieut.-Col. J. S. Ryley, of Edinburgh. Col. Ryley commenced his experiments in 1855, before he left India, by mixing it with finely-powdered wood charcoal, which, though combustible rendered the gunpowder far less dangerous, as it filled up interstices, and caused it to burn when fire was applied to it like a squib. By subsequent experiments, he found bone-dust far better suited to the purpose; but the presence of gelatine being objected to, he finally decided on trying bone-ash to which he gave the preference. His great desire was to give the Government the full advantage of his invention, without the restriction of a patent, and with this view it was described to General Lefroy, President Ordnance Select Committee at Woolwich, on November 12, 1864, and afterwards to General Sir J. Burgoyne, President Magazine Committee, on December 12, 1864, at the War office. In order still further to ensure that sufficient attention was paid to the invention, he forwarded a letter on Dec. 16, 1864, to Capt. the Hon. G. Wrottesley, Secretary Magazine Committee, stating to him, for the information of General Sir J. Burgoyne, President, and the members of the Committee on Magazines then sitting, that he had succeeded in discovering a plan of storing gunpowder, by which its explosive power was reduced to the lowest degree, by mixing a certain substance with it, which could be separated when the gunpowder was required for use without difficulty, and without the least possible injury to the gunpowder; also that, if fire be applied to the gunpowder when stored in accordance with his plan, instead of exploding *en masse* in the usual manner, it would merely burn like a squib. Yet, on January 16 1865 the Secretary of State for War directed General St. George, Director of Ordnance, to inform him that his method "had been duly considered, but that it was not found to possess sufficient advantage to warrant its adoption." He was thus led to believe that the authorities at the War Office did not look with favour on this or any similar plan for protecting the lives of the liege's from disastrous explosions; and, therefore, was scarcely prepared to find that eight months subsequently, when a similar process was submitted by Mr. Gale to the War authorities at Woolwich and elsewhere, it was considered sufficiently novel and efficacious to command the unqualified praise and admiration of the Secretary of State for War, who witnessed it at Wimbledon, and marked his approbation of the same by having it re-exhibited at his express desire before the Ordnance Select Committee at Woolwich. Colonel Ryley claims that the material which he uses is much better qualified for the purpose than what Mr. Gale proposes to use. The particles of glass used by Mr. Gale are hard and gritty, and will necessarily tend to grind and rub down the grains of gunpowder, whilst the difference in the specific gravity of the gunpowder and glass renders it easy for the particles of gunpowder to separate from the protective agent by mere agitation. On the other hand, the bone-ash he uses is comparatively soft, possesses no angular corners, and is thus incapable of grinding and injuring the grains of gunpowder; whilst at the same time the specificed gravities of bone-ash and gunpowder are so nearly alike, that agitation of the gunpowder protected by it does not tend to separate the gunpowder from the protective agent. He further states that he has some gunpowder which has been mixed with bone ash since December last, which, on being separated from the same, was tried in an *eprouvette*, and found to be as good as when first mixed.

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The English Mechanic,

AND

MIRROR OF SCIENCE AND ART.

FRIDAY, FEBRUARY 2ND, 1866.

HOFFMANN AND LICHT'S BRICK-KILN.

IT is a well-known fact that a great loss of heat occurs in the ordinary modes of burning bricks in common kilns. This loss arises in a two-fold way. First, during the burning of the bricks the air which has passed through the fuel, or among the heated bricks and the smoke and gaseous products of combustion generally, passes away from the kiln to waste at a very high temperature, even at a red heat, during a considerable part of the process. Second, when the bricks are raised to the high temperature required to burn them, and render them permanently hard, the great store of heat which they contain is entirely thrown

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to waste while they are left to cool. A new kind of kiln, having a perpetually revolving fire, has been introduced into Ireland, where it is used for both brick burning and lime burning. It is the invention of the two gentlemen named at the head of this paper. For a description of this improved kiln we are indebted to Professor James Thomson, of Belfast.

In this kiln economy of fuel is effected in two ways—in fact, by saving the two-fold loss of heat already mentioned; for, first, it saves the heat of the gaseous products of combustion and unconsumed air passing through and away from the burning bricks, by applying this heat effectively in drying the new fresh bricks about to be burnt and raising them up to an incandescent temperature, so that only a very slight addition of heat directly from ignited fuel is required to complete their burning; and, secondly, it saves the heat of the cooling bricks, after their having been sufficiently fired, by applying it all in warming the air supplying the fires: so that the fuel is burnt with air already at an incandescent temperature, instead of requiring, as usual, to heat the air for its own combustion. One of these kilns, now being constructed in the neighbourhood of Belfast, will serve to describe the general idea.

The kiln is built in the form of a large arched passage like a tunnel, bending round in going forward till it closes with itself to form a circular ring chamber, within which the burning of the bricks is carried on; 160 feet is a suitable size for this chamber. Round its circumference are twenty-four entrance ways, which can be readily closed for the retention of heat and the exclusion of air. Thus the ring-chamber may be conceived of as consisting of twenty-four compartments, with a door-way to each. In the centre of the ring a lofty chimney is erected, and from each of these twenty-four spaces an underground flue leads to the chimney, each flue having a valve by which to cut off communication. Arrangements are made by which a damper can be let down at pleasure between any of the compartments, and so to isolate such as it may be desired so to treat. Once the fire is lit it is never extinguished, but the burning of the bricks and the removal of the finished product is carried on by a continuous process. Suppose the kiln at work; on this day two adjacent compartments have their entrance-doors open, the remainder being perfectly closed. By the arrangement of the valves in the flues, and the large damper, the air, which gains admittance alone by the two open doors, has to make the whole circuit of the ring kiln in order to be drawn into the chimney. From one of the two open compartments men are taking out the finished and cooled bricks, and in the other they are building up newly-formed unburnt bricks not quite dry. The air entering passes first among bricks almost cold and takes up their heat; it then goes on to warmer bricks, and then to those still warmer, always carrying the heat of the cooling bricks forward with it till it reaches that part of the ring nearly diametrically opposite to the two open and cold compartments. At this point it gets a final accession of heat from the burning of a very small quantity of coal dust, which is dropped in among the bricks from time to time by numerous small openings, furnished with air-tight moveable lids. Thus, at this point there is generated the full intensity of heat which is required for the burning of bricks. The hot air, including the products of combustion, then passes forward to the bricks which, by its continuous current, are being heated, and it passes through among them, heating as it goes; then to those which are still damp, drying them in its passage; and so on up the chimney, whence it makes its exit nearly cold, and saturated with moisture, in the form of steam or vapour, taken up from the damp bricks.

On the day following that on which the above operations have been going on, the damper is shifted forward one compartment; the place where the coal dust for fuel is thrown in is also advanced a stage; and the whole process is repeated. Thus, day by day one compartment is built up and another unloaded, the whole being left dormant on Sunday, by simply closing the apertures for the admission of air.

The same kind of kiln, with the same process of working, serves for lime-burning; and we are assured that the saving of fuel, compared with that consumed by the ordinary apparata, is something nearly incredible. We shall be happy to record a trial of this kiln nearer home, where its economy is so much required now that coals are decidedly on the "upward turn."

ALL ON THE TWIST.

THIS phrase has not been taken as the text to a long sermon against the contrariness of things in general, or the warping ability of wood in particular; to impart a little information on twists or spirals worked on the lathe and to stir up some curiosity about them is the aim and intent of the present communication.

A spiral may be said to be a kind of screw with a rapid pitch, but such a definition scarcely includes detached spirals, a class where one or more cylinders with a corkscrew turn in them, standing on a base, support a capital, and so do duty for a twisted column, the upright of a candlestick, or else form a spiral brace in the framed works of the cabinet maker. For convenience it will be as well to distinguish the following varieties: such as are simply waved; such as are waved, but the hollows meet in a sharp edge or arris; and such as are detached, the corkscrew variety in fact. These last two are capable of being ornamented, the hollows can meet in a fillet, a waved, zigzag, or other moulding, and the corkscrews can be of any suitable section, have any mouldings worked on their exterior faces, or the alternate ones can be wavey as well as coiled.

The simple spiral continues to repeat itself at equal intervals, as the French phrase it, *i.e.*, have the coils placed at equal distances; but there are others in which the middle or end coils are compressed—this sort has gone very much out of use, probably from a growing ignorance of the mode of dividing them out, and if the writer can only succeed in winning for them a little more of the attention they so justly deserve, he will deem his time very well spent.

The first operation in the making of spirals in a common lathe, is to mark them out; the second, to saw or rasp out the hollows; and the third, to work them smooth with gouges, finer rasps, and glass paper. Marking out can be effected in three ways. Supposing that a twist of six coils is wanted on two feet of length, this will give one coil in four inches. 1. The object being rounded, four lines are drawn lengthways along the cylinder at equal distances from each other, to join, that is, the extremities of two diameters crossing each other at right angles, and similarly placed at each end of the object. Commencing at one end a point is marked at every four inches along one of these lines, on the next (right-hand or left according as a right hand or left-hand twist is required) marks four inches apart are made, but these commence at one inch from the end, on the third line they commence at two inches from the end, and on the fourth at three inches. When these marks are joined continuously, the line drawn will form a regular spiral. If eight lines instead of four are drawn along the cylinder, one-eighth of the pitch, half an inch in this instance will have to be allowed extra at the commencement of each new line. This method can be used where the cylinder bulges in any part of its length, and when more members or detached spiral cylinders (corkscrews) are required, they can be sketched out parallel to the spiral first obtained. When the cylinder is true, a neater way (2) of proceeding, and one that is none the worse for being two centuries old, is to enwrap the object in a strip of paper, the edges of which will just meet round it, then lay it out flat and mark off the six divisions along each edge. From the corner of the paper rule to division number 1, say, on the right, then from 1 on the left to 2 on the right, and so on till the opposite corner of the paper is arrived at. The six lines thus drawn will join and form one spiral, when the paper is glued or wrapped round the object to be twisted. 3. A knife with a curved cutting edge, imbedded in a semi-cylindrical groove, will also trace out spirals very accurately, but not the compressed ones, of which we must now speak.

Supposing the coils are ten in the entire length, and the middle ones are required to be three times as close as those at the end. In half the length there are five coils, the space between the end ones is 3 dimensions and between the middle ones 1. Our first step is to calculate three mean proportionals between 3 and 1. This is effected by multiplying the 3 by the 1 (the two extremes) and extracting the square root of the product $\sqrt{3 \times 1} = 1{\cdot}7$ for the second mean; $\sqrt{1{\cdot}7 \times 3} = 2{\cdot}2$, the first mean; $\sqrt{1{\cdot}7 \times 1} = 1{\cdot}3$ the third mean. The distances the five coils must be apart are therefore 3, 2·2, 1·7, 1·3 and 1. The total of these is 9·2 or 9 1-5th. One-half the length is to be divided into 9 1-5th portions, or more correctly into 46 equal parts. A strip of paper which will just enwraps the cylinder must be thus divided along one edge, and a mark made at the 15th division, which answers to the 3 in our list of distances. Mark onwards from this (counting 5 divisions on the edge as 1 whole and each division as 2-10th) 2 2-10th, and again 1 7-10th, 1 3-10th and 1. Rule lines straight across the paper at each of these marks and then rule from the corner of the paper to the 3, from opposite the 3 to the 2 2-10th mark, and so on; these lines will not be parallels as in simple spirals. Replace the paper round the cylinder—the continuous spiral will be quite true, and then proceed to cut hollows between the line thus obtained. If an even number of coils is required on half the length, 4, 8, 12, 16, &c., on the whole length, it will be generally the best method to leave one coil at either, not each, end of the same width as the one adjoining it, thus avoiding the trouble of calculating four, six or eight means. A plan of obtaining these means by a constructed diagram can easily be developed by anyone who is interested in the problem. If the coils are required to be compressed at each end, the marking off will have to be commenced at the smaller figures of the list we calculated—at the 1, that is; proceed to the 3, repeat the 3, and then to return to the 1. Having settled the marking of our spirals, we take the wood from the lathe and proceed to hollow out between the coils either with a common saw, a float, or a plate of box-wood with gouge-shaped cutters attached to it and worked as a circular saw; but if the spirals are detached, and even in number, a Willis's or any fret saw will cut them out in the rough, ready for the after operation of rasping up, which is done between centres. A spiral with sharp edges requires careful management of the rasp, but some experts work correctly and expeditiously with a gouge, just as the turners of cores or patterns for the fringe-makers turn them, with no other guide but the action of their fingers along the adjacent hollow they first roughly cut out. There must be some quicker mode of twisting bed-post and shafts well known in the metropolis, or such work could not be executed at the low prices charged; none of the following methods can be cheap, from the expensiveness of the apparatus required.

It seems reasonable to suppose that a gouge or other shaped cutter could be secured to a guiding stock or nut, and carry the tool correctly along the roughly formed hollow and so perfect the spiral. The method of working twists by a gliding mandril has the advantage of enabling one to work those with wavey ridges or arrises, and if detached ones, to make them in any wave or zigzag. In this case a model or copy of about two turns length is secured at the extreme left of the mandril, and a rubber operating on it guides the mandril in its spiral movement. If this model or copy has a division-plate attached to it, any number of members can be correctly placed round the object to be twisted. A third method of cutting spirals is on a self acting lathe, by a gouge tool in the slide-rest, the motion being given by overhead pulleys or otherwise to the leading screw and attached saddle, and communicated by means of a pinion on the leading screw which moves the change wheels; these are arranged so as to diminish as much as possible the revolutions of the mandril or object to be turned. A fourth method by the copying or Blanchard lathe is available where no undercutting is requisite, but the cutter of such a lathe requires too great a velocity for a common foot lathe. A

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fifth method by a fly-cutter would be effective in every instance. A fly-cutter is a revolving tool, with its cutter placed at right angles to its axis; a worm on this axis might work a wheel on another axis and transmit the motion at a greatly reduced speed to the change wheels, and thus cause the mandril to revolve slowly. The left or right-hand direction would of course be regulated by the change wheels as in ordinary screw-cutting. Detached spirals might be pierced by a gouge tool with cutting edge at the side, as in Bernier and Arbey's morticing machine, or with a cutter like the one used in the American machines for cutting the hollow in a rifle-stock for receiving the barrel.

One would naturally suppose that a good spiral turning lathe would have been shown in the Exhibition of 1862—there was nothing of the kind, and the able writer of *The Practical Mechanic's Record* of the same laments that "one of the most interesting forms of French wood-lathe is not exhibited, namely, the 'Machine à canneler droit et torse, spiralment,' that by which nearly all the beautiful twisted French cabinet work is wrought. It is wholly different from the Blanchard lathe."

An apparatus of this kind is probably the one used by Mr. Joseph Peel, Pudsey, near Leeds, who, in a letter to the writer, uses these words, "I have no traverse on my mandril for spiral purposes, can produce any amount of members at any desired angle, either right or left, of any form or section—it is to all intents and purposes 'Turning.' I have lately cut two rods, each ¾ inch diameter and 2 feet 8 inches long, light and open like basket work, with three strands twisting round a central stem not more than ⅛ inch in diameter from end to end." Surely such a man deserves to have "a valuable consideration" ere he will further disclose his system to anyone.

HERBERT HURST.

PRACTICAL PHOTOGRAPHY.*

V.

I use the same bath for positives and negatives—the pyrogallic and silver solutions for intensifying wet plates and developing dry only in different proportions. Cyanide for all fixing purposes, except printed paper. I do not say that this plan is by any means accurate, but I have good reason to be satisfied. Beware of getting the cyanide into the system—it will make you nervous and weary, sick and irritable with yourself, and everyone else about you. It is a TERRIBLE POISON, so be careful you do not use it with a cut or a scratch on your hands. So too is bichloride of mercury, but you will seldom use much of it; in fact, very soon look on it as one of those "dodges" described in that most laughable statement of a photographic man in "London Labour and London Poor," vol. iii., p. 206. When you get a good formula, keep to it; trying one thing and another is only a loss of time. After preparing the chemicals, you may turn your attention to the state of the camera. Work with the feeling that you are sure to succeed, that failures and disappointments are mere accidentals; proceed carefully, and you will the more easily detect anything wrong. Place your camera in a strong light, leave the cap on the lense, draw out the ground-glass slide, cover your head well and scrutinize the interior carefully to see that not a ray of light enters. If satisfactory, put in the dark slide, draw up the inside panel, take out the rack work and reverse the camera for a second investigation.

2ndly. Focus an object on the ground-glass, then place in the dark slide and carrier with a semi-opaque glass in position, raise both back and front of the dark slide, observe whether the object focussed is equally sharp without a re adjustment of the lens; if not, this must be corrected. Observe that the *lenses* are always free from damp or dust before you commence work, and of course the body of the camera. With a small lens the object is not always equally sharp in the centre and sides of the picture; try a smaller stop; but though the smaller the stop the sharper the picture, on the other hand a longer exposure of the plate is necessary. See that the glasses you intend to use will fit the carrier before you clean them—file off the sharp edges.

When you are ready and anxious to practise, do not annoy your friends by repeatedly taking distorted resemblances. Imagine you are proposing for your first trial that of a lady—you are met with the inquiry, what colour had I better be taken in? Now colours are represented in photography by intermediate shades of black and white. You may well begin by drawing and colouring on a large sheet of paper a diagram somewhat of this sort:—

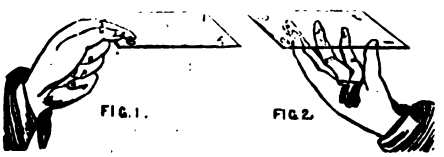
White.	Yellow.	Red.	Blue.	Brown.	Green.	Black.

Draw a black margin round, and then photograph it. The variety of shades will afford a hint. The same may be said with a view to printing. But the study of colour with regard to appurtenances is a different branch of art. For harmony and contrast I may advise you to get a cheap edition of "Chevreul on Colour." I will just add before closing this chapter, do not think of taking a lesson till you have made some progress; if you meet with a failure or an accident, I think the books I have mentioned will help you through, but do not resort to a friend for advice at every step—read and puzzle out your difficulties. Keep your "defects" by you, varnish them if you like; till you consult some friend, a glance will more readily explain the cause than any description. PLODDER.

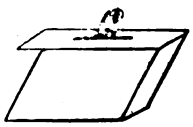
CHAP. VI.

Some descriptions of glass never have a clear bright appearance, a fault arising from some defect in the manufacture. A plate of good glass, free from blemishes and chemically clean, is a beautiful object. To be particular at first is to encourage a habit which will soon be to you absolutely necessary to the attainment of a good picture, and at the same time will save endless annoyances and disappointments.

Before commencing to coat a plate of glass with collodion, it is a good plan to go through the manipulation with a bottle of water, observing all the gravity which should attend the use of the real article. It takes some little practice to coat a plate evenly, so that it is as well to save the collodion till you can do what you require with water. There are two ways generally in use of holding the plate. For a beginner the second form



is a good one. Before pouring on the collodion, pass the camel hair brush lightly over the surface to take off any particle of remaining dust. For whatever purpose the bath may be required it is as well to have one that will act quickly. The formula I have given as in use is a very good one, and for all ordinary purposes may be considered as instantaneous, if this expression is correct. The developer may be used of the same strength in winter with a silver bath containing 30 to the ounce of water, or this bath in summer with the developer diluted one half. Do not lay in a large stock of collodion. When mixed, it rapidly deteriorates if kept, and becomes thick and dark brown, from the amount of free iodine. In this case, Mr. Hardwick states, "When this collodion becomes highly coloured and insensitive, a part of the free iodine may be removed by a strip of pure zinc or silver foil; also the metallic powder obtained by reducing nitrate of silver with sulphate of iron acidified with nitric acid, answers very well for the same purpose." Mr. Ash Hadow gives as his experience also that "a little oil of cloves in proportion of four drops to each ounce, causes a surprising increase of sensitiveness." (*Circle of Sciences*, vol vii.) On the other hand, if the collodion is too pale when required for use, tincture of iodine, just one drop to the ounce, will be found of service. When you get a good sample of collodion keep to it. The difference of quality and the uncertainty of its action sometimes causes grievous annoyances. The film may be too thick or too thin, or too weak, and crack in the bath. As a rule, the more alcohol the collodion contains the more tender is the film. After immersion and before placing the plate in the carrier, wipe the back with a pellet of blotting paper. The plate should remain in the bath at least a minute; if taken out before it will have an irregular greasy appearance. While the plate is in the bath you may proceed to fill your developing glass; see that the water is handy. Measure, if for a negative, two drachms of the pyrogallic solution and place it in a convenient position, lay a strip of blotting paper on the lower edge of the carrier to absorb any moisture, then lift the plate up and down in the bath once or twice to facilitate the evaporation of the ether in the collodion. The plate should not be handled more than is absolutely necessary. After preparing a few plates the thumb and fingers will become stained, then blackened, and ultimately severely blistered, causing the skin to come off, unless the pumice stone is frequently used. The sooner the better after the day's work, the nails, if stained, may be scraped; avoid using any covering for the fingers, indiarubber stoles harbour dirt and make stains. Then as to your linen, the wristbands will be destroyed, unless great care is taken at the time, and any marks removed before the linen is washed. Be careful to put an old kerchief in your pocket, a set of kerchiefs are easily destroyed by just slipping the finger and thumb in the pocket to dry them. If your bath has not a cover to screw down, which will be the case if you use an ordinary one of earthenware, it will be as well to cut a slit in a piece of wood and lay it on the bath to keep out



any light and dust. The bath solution may be filtered at the close of the day's work; it is a good plan I find to keep the glass funnel always in the bottle, which not only prevents dust from entering, but the very slight evaporation helps to keep up the equal quality of the solution. After some days' usage the bath will have a peculiar smell of ether and iodine; to cleanse it a simple plan is first to neutralise it, then pour the contents into shallow dishes; expose in the sun. In a very short time the impurities will be thrown down probably in the form of a reddish deposit—filter and with the Argentometer observe the density, you may then either dilute or add more fresh bath as the case may require. Be careful how you neutralise. You may at first be entirely deceived, for on adding few drops of carbonate solution a beautiful woolly shower will be precipated. You may suppose this to be impurity, and go on adding drop after drop, and yet still more, all the while admiring the beautiful miniature snow storm, till at length the Argentometer will give you the unpleasantest discovery that you have been throwing down the silver, and that the bath is little more than water. Pipe clay, chalk, or whiting are the best substances wherewithal to neutralise.

(To be continued.)

THE LATE MR. JOSEPH LOCKE, C.E.—A statue to the memory of the late Mr. Joseph Locke, C.E., M.P., has for some time stood veiled in Barnsley Park, is now open to public view.

Artists may be informed that pictures intended for exhibition at the Crystal Palace in the forthcoming season must be sent to the Hanover-square Rooms on Monday and Tuesday, March 5 and 6, from ten to five; or, if from the country, direct to the Palace. We are glad to hear of the growing estimation in which the gallery is held. Since it was removed to its central position in the palace and it has been managed by its present superintendent, Mr. Wase, the sales have amounted to £25,308, figures which will bear comparison with the proceeds of many London and provincial exhibitions.

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SEWING MACHINERY.

II.

CONSTRUCTION OF SINGLE-THREAD MACHINES.

THIS relates, firstly, to an arrangement of mechanism which will greatly simplify the construction of sewing machines intended to form the ordinary chain or tambour stitch. In this improved machine the chain or tambour stitch sewing is produced by the aid of a looper, which rotates in a horizontal plane and takes up the loop formed by the vertical needle and holds it open until it is entered and secured by the next descent of the needle.

Figs. 7 to 11 represent the looper. It consists of a hook A formed upon the end of a short hollow cylinder, which is mounted vertically in a socket in the upper end of the driving shaft B of the machine, as shown in the section of the machine. Fig. 12. The upper end of this cylinder is cut away, as shown in Fig 7, which is an end view of the same, and is formed into a point *e* and a heel *a*. Fig. 8 is an elevation of the cylinder showing the edge form of the hook A, and a groove *i* running round the cylinder below the hook. The cylinder with its looper is rotated as indicated by the arrow. Fig. 9 shows the hook in a position ready for the point *e* to enter the loop of the needle thread *n*, that loop having been brought into position through the intervention of the needle *m*, and other parts of the machine, the hook then nearly completes a rotation, the needle is withdrawn, and the feed plate C, Fig. 12, operates, which brings the thread into the position in Fig. 10, with the loop extended and ready for the needle to enter it at its next descent, as in Fig. 11, which shows the needle having entered the loop and slightly withdrawn, preparatory to the hook A entering the needle loop *n*, and as the point *e* of the hook enters the needle loop *n*, and continues to rotate, the loop of thread which lies around the hook in the groove *i*, is cast off at the heel of the hook *a*, and is drawn up to complete the stitch. The formation of a line of stitches is obtained by a continuation of the above described movements.

The arrangement of parts in Fig. 12 for driving the needle *m*, looper A, and feed plate C, and their mode of working will be obvious to any one acquainted with the construction and working of sewing machines—the eccentric D on the driving shaft serving to operate through a connecting rod the racking arm which carries the needle *m* and the double cam E on the driving shaft, together with a spring F, serving to operate the feed plate C.

The invention relates, secondly, to certain mechanical means for improving the quality of the work produced by single thread or chain stitch machines. The objects of the improvments are to sew a looped seam without twisting the loops on the underside of the cloth, and also to form at pleasure either long or short stitches alternately or equal length stitches. In this arrangement a reciprocating vertical needle and a rotating double-headed looping hook are used, their actions so timed that the needle shall perforate the fabric twice for each revolution of the double-headed looping hook, and that this latter shall draw each loop of needle thread through the preceding loop.

Fig. 13 represents part of a side elevation of a machine embodying the improvements. Fig. 14 represents a vertical longitudinal section of a part of the machine. Fig. 15 represents a plan of the same with parts removed. And Figs. 16 to 25 represent certain parts of the machine detached from the remainder, and placed in different positions which they occupy during sewing, and designated by the same letters of reference as are applied to the same parts in the other illustrations. A is a double-headed rotating hook or looper, which works beneath the table plate B, whereon the material to be sewn is placed. C is the needle bar which slides up and down in the guide box D, secured as usual to the extremity of the bracket arm E, extending from the bed frame F of the machine. The double-headed looping hook has two hook heads *a*, *a*, placed diametrically opposite to each other, and projecting in opposite directions from the body of the hook, and the back a^1, a^1, of each head of the hook is extended so far that it does not let off the loop of thread seized by the hook until the needle has entered it in its descent to deliver a loop of thread to the hook point following the back of the head which lets off the loop. That the back of the head of each hook may not prevent the descent of the needle for this purpose each is slotted as shown in Fig. 17, to form a groove into which the needle can descend. The double-headed looping hook revolves in a circular groove in a ring support G, projecting from the bed plate, and held in said groove by a ring cap *b*. The driving of the double-headed looping hook is effected by connecting it with a shaft H, to which a pulley J is secured, receiving the belt from the treadle, and that the loop seized by the hook heads may escape the looper A its connection with the driving shaft is formed by means of two pins *m*, *m*, which enter sockets in the body of the looper. Each of these pins is contained in a separate socket in a hub K, secured to the revolving shaft H, and each has a head *c*, which is borne against a stationary face cam I, by a helical spring in the pin socket. The upper part of the cam recedes from the looper as seen at Figs. 14, 15, and 18, so that as each pin is carried by the revolution of the shaft H along this receding portion its head is compelled by the spring to follow the inclination of the cam, and its point is withdrawn from the socket in the double-headed looper to permit the loop of thread to escape. As the receding portion of the cam extends but a short distance and then approaches the looper, the withdrawn pin is caused to re-engage with the looper before the other pin is withdrawn in turn, so that the double-headed hook is always coupled with the shaft. The needle bar C moves up and down by a rock shaft L passing through the hollow bracket arm E. The front end of this rock shaft is fitted with an arm *n*, connected with the needle bar by a link O, so that as the shaft L rocks to and fro the needle bar and the needle *d* carried by it are alternately depressed and raised. That the needle bar may make two descents for each revolution of the double-headed looper, the rock shaft L is connected with the revolving shaft H by an arm P, a connecting rod Q, two pins *f*, *f*, and two slides, *g*, *g*, moving in cross slots, *h*, *h*, formed in a socket in the hub of the pulley. The needle *d* is secured in the needle bar C by a clamp screw *i*; when it is depressed its point passes down through a hole in the table plate B, and carries the loop of thread in its eye within the range of motion of the hooked points of the looper, and the motions of the needle bar and looper are so timed that one hooked point of the looper passes by the needle and enters the loop of thread carried by it, as the needle rises and permits the loop to swell outward from its side. The hook points of the looper are arranged to pass close to the stem of the needle at the side nearest the cam I.

BISULPHIDE OF CARBON PRISM.

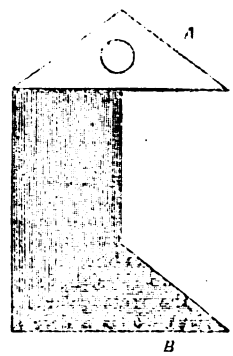
By G. BARLOW.

Several years ago, having a desire to become practically acquainted with the nature of the prismatic or solar spectrum, I soon found that it was impossible to conduct experiments with any degree of accuracy in the absence of a first-class prism. Being acquainted with the great refractive and dispersive powers of bisulphide of carbon, I determined to see what could be done with it in the way of making a prism by enclosing it between plates of patent plate glass; at that time I was not aware that it had already been used for that purpose, and was ignorant of the method employed for cementing together the glasses. For this purpose I tried many substances, and at length found that gelatine possessed qualities in many respects highly desirable, being unaffected by the bisulphide after being immersed in it for a considerable period. The next point was to ascertain the best mode of applying it to the edges of the glass; this I conceived would be best accomplished by saturating bibulous paper with it, and so covering the joints with a film of gelatine supported by the fibres of the paper. This plan answered pretty well, but the gelatine contracted so in drying as sometimes to cause the paper to turn up from the glass; this was especially the case when a strong solution had been used. To remedy this defect I added to the gelatine a little glycerine to give it elasticity. When, in addition, proper precautions were taken to free the glass from every trace of greasy matter (which is apt to get on during the putting together of the various parts) this combination was found to answer admirably. I found the glass most readily freed from oleaginous matter by a weak solution of carbonate of soda carefully wiped off with a wet cloth and finished with a dry one.

At first I constructed the entire case of glass: the top, bottom, and one of the sides being composed of strong brass. The annexed figure exhibits the brass portion of the instrument.

It may readily be made out of one piece of rolled metal by turning down the ends to form the top and bottom. In one of the ends a hole is drilled in which a cork is inserted.

The gelatine will adhere equally to the metal as to the glass, providing the same care be taken to remove grease. In practice I have found it necessary to give the inside a coat of the same gelatine which is used to cement on the glasses. This prevents the bisulphide from acting upon the metal, an effect which takes place in the course of a few months, and which is rendered evident by a yellowish deposit on the glass.



After having made the brass frame of the size and shape desired, and for accuracy having arranged the sides *a* and *b* parallel, the glasses being already ground to the right size and shape may be cemented to the frame with a little of the gelatine solution, which should be allowed to dry with the object of keeping the glasses in their place. This makes the last operation—viz., that of applying the strips of bibulous paper saturated with the gelatine solution, comparatively easy. The strips of paper should turn over on to the surface of the glass from one-eighth to three-sixteenths of an inch. The following is the best formula for the gelatine solution:—Gelatine 100 gr., glycerine 26 drops, water one ounce. The gelatine used by me cost 1s. 4d. per pound, but probably commoner kinds would answer equally well.

I may remark that I have found bisulphide of carbon prisms sent out with spectroscopes which were cemented with shell-lac. In prisms thus constructed I have observed the formation in the liquid of numerous small bits which float about in the liquid, and must be more or less detrimental to its perfect working.

Those who are not aware of the fact will be pleased to learn that a bisulphide of carbon prism will enable them to see some of the celebrated Fraunhofer lines with considerable distinctness by simply looking through the prism at a fine rectangular slit made of two knife edges. I do not claim this as a new discovery, but I am satisfied that it is a fact that many persons well versed in physics are unacquainted with.

The lines are best seen by using diffused solar or direct lunar light.

To those interested in spectral researches the bisulphide of carbon prism is both a cheap and most valuable instrument when properly made, and will enable any one to make himself practically acquainted with the solar or prismatic spectrum

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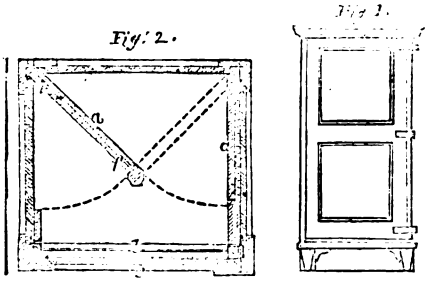
who otherwise might be debarred the pleasure, as a really good glass prism is quite beyond the means of all but the few; besides which several are required to do the work which one bisulphide of carbon prism will perform.—*Extracted from the Chemical News, January* 19.

PEPPER AND TOBIN'S IMPROVED APPARATUS FOR ILLUSORY EXHIBITIONS.

As shown, Fig. 1 is an exterior, and Fig. 2 a horizontal, section of a wooden box or chamber for containing the objects and subjects of representation and illusory exhibitions. *a*, *a*, are two doors hung at the angles of the box and capable of closing on the post *d*, or of living back in a recess in the sides as shown on the right-hand side of the box. These doors, *a*, *a*, have glass mirrors on the sides *f*, *f*, *f*, and a fresco or design at the upper part of the box, suitable for the illusion to be represented. The post *d*, is set at the junction of the lines, bisecting the angles of the back and



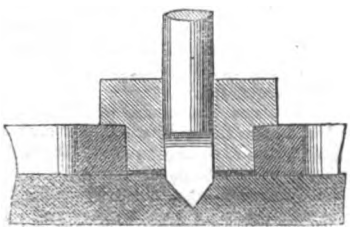
sides. The box, as shown, is rectangular. If, for convenience, or for the purpose of any particular representation, the box is to be wider at the front than at the back, the post will still be placed at the junction of the two lines bisecting the angles made by the back and two sides, but any considerable departure from the rectangular form would be found inconvenient. *b* is a door of clear thick plate glass; *c* is the the external door. A lamp is hung at the top of the post *d*, to light and assist in ventilating the box, by promoting an upward current, and a mat or rug is placed at the bottom of the box or chamber.

The patentees claim, "a box or chamber constructed and arranged with mirrors, as above described, for the purpose of illusory exhibitions."—*Newton's Journal of Arts.*

DRILLING TUBE-PLATES.

We extract the following from the second number of *Engineering*, a journal got up with considerable talent, and to which we cordially direct the attention of our readers:—

"When a number of similar tube plates have to be drilled, the form of template shown by the accompanying figure will be found useful. The template in this case consists of an iron plate ¾ or ⅞ in. thick, in which are drilled all the holes to be



afterwards formed in the tubeplate. Into these holes is fitted a steel bush or nut, having through its centre a hole in which a round shanked drill can work. The template is placed in the proper position upon the tubeplate to be drilled, and secured by cramps. The steel bush is then placed in each hole successively, and the holes in the tubeplate drilled through it by means of a rounded shanked drill, the drill being guided by the steel bush, as shown in the cut. The small hole made by the drill is afterwards enlarged by a boring bar and cutter in the usual way, the template being, of course, removed.

FASTENINGS FOR DOORS, WINDOWS, &c.

The following has been placed at our disposal by a correspondent. It describes purposed improvements in fastenings for doors, &c., by Mr. Meek, of Crane-court, Fleet street, and Mr. Howes, of Curtain-road, Shoreditch. These gentlemen secured provisional protection only for their ideas, but went no further. Some one else may be able to improve on the "improvement," which relates to certain peculiar constructions and arrangements of spring bolts and sockets for the same, latches and locks for securing doors, window sashes, and drawers, and applicable generally to cabinet furniture, in which doors or drawers are required. According to one part of this invention it is proposed to make the socket for receiving the end of a bolt when applied to the bottom of a door, and made to shoot downwards into such socket, which is to be let into the floor, so that no accumulation of dirt may take place in the socket; for this purpose a sliding metal plug is fitted inside the socket, which should be of a tubular form, such plug being forced upwards by a helical spring inside the socket, and maintained flush with the top of such socket, so as to close the hole when the bolt is withdrawn, and thereby prevent the entrance of dirt therein. Any ordinary bolt may be used with this socket; or a spring bolt may be employed of a peculiar construction. This spring bolt is contained within a tubular socket, and is forced outwards by means of a helical spring within the tubular socket; the bolt is drawn back by means of a small handle, the shank of which passes through a slot in the side of the tubular socket. A bayonet slot is employed to hold the bolt back when withdrawn, and a slight return slot or notch is made in the bayonet slot to retain the shank of the handle when brought therein by a slight turn of the bolt. This socket and spring bolt may be applied to the side of a door or to a sash frame; or the spring bolt and socket may be used as a substitute for the ordinary safety chains of doors by placing the spring socket some little distance back from the door, and fitting an anti-friction roller to the botoom of the spring bolt, so that when the bolt is released and the door opened the roller in the bolt will run along the floor and drop into the spring socket, thus preventing the closing again or further opening of the door till the spring bolt has been raised. It was also proposed to make spring latches for outer and other doors by introducing a hollow sliding latch bolt inside a tubular socket, such latch bolt being bevelled at the outer end so as to sneck into the catch plate, whilst its inner end is pressed against by a helical spring contained inside the tubular socket. The latch bolt may be withdrawn by a knob or handle inside the house, and may be opened from the outside by a latch key adapted to any convenient or well known tumbler or other lock, placed inside the hollow latch bolt.

Another part of the invention relates to a form of lock intended to be used as a substitute for mortice locks, and consists in fitting the latch bolt so as to slide freely in a tubular socket, which is to be let into the door. The latch bolt is withdrawn in the ordinary manner by a spindle and levers or tappets, and is forced outwards by a helical spring inside the tubular socket. If desired a key may be also applied to these locks or latches with a view to preventing the latch bolt from being withdrawn when the key is partly turned round, thereby fixing the latch bolt. This key may be made to act on a sliding catch or bolt inside the hollow latch bolt, such sliding catch or bolt being forced against the levers or tappets, and so preventing them from moving and drawing back the latch bolt, or if desired the key may be made to shoot the latch bolt further out from its socket or case. India-rubber springs might be substituted for the helical metal springs in these various fastenings.

PROGRESS OF SCIENCE.

HOW TO MAKE GOLD.—M. Frantz, a metallurgist, and M. Henri Faure, editor of the *France Medicale*, have just announced to the learned world that they have discovered a method for transmuting silver, copper, and mercury into gold, "which," they say, "are only one and the same metal in different dynamic states."

M. SAYERS has recently discovered a substitute for the magnesium light, which promises to be of much service to photographers. Twenty-four parts by weight of nitrate of potash, seven parts of flowers of sulphur, and six parts of red sulphide of arsenic, are thoroughly mixed. This composition, when set on fire, affords a most brilliant light, and the negatives produced with it give excellent positives.

THE construction of a new spectroscope is described by Mr. Josiah P. Cooke in the new number of the *American Journal of Science*, and illustrated by woodcuts. He states that a number of prisms are so arranged that the angle of minimum deviation for any ray may be accurately measured and its position in the solar spectrum determined. Mr. Cooke gives the results of various observations and the measurements based thereon.

Two notes on the surface of the sun, by Professor John Phillips, appear in the new number of the *Proceedings of the Royal Society*, with engraved illustrations. In the first the Professor remarks on what he terms the porosity of the sun's surface as disclosed by a powerful glass, when it previously appeared even and marble-like, without any dark patches. In the second note he records the various positions of a sun-spot observed at intervals during one rotation.

MECHANICAL POWER FROM SUNSHINE.—M. Babinet has recently communicated to the Academy of Sciences an account of some experiments by M. Mouchot, Professor of Mathematics at Alencon, on the mechanical effects produced by confined air heated by the rays of the sun. In these experiments M. Mouchot employed a cylindrical vessel of thin silver, blackened on the outside, and enclosed within two cylinders of glass, placed one inside the other. The office of the glass cylinders, of course, was to prevent the heat which might pass through them to the blackened silver cylinder being radiated back again—glass, while affording a free passage to the direct rays of the sun, being practically opaque to radiant heat. The silver cylinder was half filled with water, and an air-tight cover was then fitted on it; a tube, fitted with a stop cock, passing vertically through this cover to very nearly the bottom of the vessel. Thus arranged, the apparatus was placed in the sun, whereupon the air in the upper part of the vessel speedily became sufficiently heated to cause it to exert so much pressure on the water under it that the latter, on the stop-cock in the tube passing through the cover of the vessel being opened, escaped in a jet more than ten metres high. This very remarkable result led M. Mouchot to construct an apparatus on the same plan, which yielded a continuous jet of water as long as the sun was shining on it. M. Babinet is of the opinion that machines on this principle might be found useful for raising water on the great scale in tropical countries.

IMPROVEMENTS IN SHIP'S COMPASSES.—A highly interesting paper has been prepared by Mr. Evan Hopkins, F.G.S., upon Terrestial Magnetism, with special reference to Iron Ships' Compasses—their deviation and its remedy, which will be read before the United Service Institution, on Monday, Jan. 28. The subject is one of such general importance to all who employ that valuable instrument that Mr. Hopkins is sure to be favoured with a large audience In our next we shall be enabled to publish an abstract of the paper, the utility of which will be at once appreciated when it is considered that he proposes to describe a compass which shall be entirely free from the inconstant variations now the source of so much danger and inconvenience, and at the same time, to avoid the application, as remedies of fixed magnets and similar arrangements, which in practice can only augment the evil.

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ART NOTES.

Earliest art is to have a special division at the Paris Exhibition. The first and earliest of implements and rude carving pertaining to the diluvian period and the age of stone will be placed by themselves, under the care of M. de Lartet, the distinguished geologist.

MR. GIBSON, THE SCULPTOR.—Last week the *Morning Post* announced the death of Mr. Gibson, the sculptor, on the previous Sunday, and several daily journals repeated the statement. The *Times*, however, states:—"We are glad to learn, by letters from Rome of the 19th instant, that this eminent sculptor is gradually recovering from his late attack, and that hopes are entertained of his restoration to health."

PHOTOGRAPHY AND PAINTING.—The reproduction of great works of art has long been regarded as one of the most useful, as it is certainly one of the most legitimate applications of photography. It is accordingly satisfactory to note the increasing number of copies of great paintings which appear in the windows of our print sellers. In this way acquaintance with the masterpieces which adorn foreign galleries, as well as with many of the *chef d'œuvres* of contemporary art, is being diffused, and pleasing memorials of foreign travel are provided. Our own photographers have still their position to make in this field of enterpise, and it is therefore satisfactory to take note of a beginning well made. Messrs. Lucas and Groom, of Wigmore-street, have published a set of photographs from pictures by modern artists, which show in an agreeable manner how much may be done in this way with the camera. It is believed that the excellent effects which they are able to produce are due to a skilful management of the falling of the light upon the picture while it is being copied. However this may be, the result is admirable. Among their publications is a reproduction of Armitage's "Esther's Banquet," Girardot's "Industry and Idleness," and two storm scenes by Duncan.

TELEGRAPHIC NOTES.

GOVERNMENT MANAGEMENT OF THE TELEGRAPH.—At a meeting of the Edinburgh Chamber of Commerce last week, Mr. George Harrison, vice president, made an interesting statement on the subject of telegraphic management, in moving that the Chamber petition for a Royal Commission on the subject. He read a letter which he had received from M. Corr von der Maeren, president of the Brussels Chamber of Commerce, in which he says that by constant battling they had succeeded in bringing down the charges to half a franc for the interior of Belgium. The charges originally were from Brussels to Paris 10f., to Marseilles 17.50f., to Berlin 15f., and to Konigsburg 20f. The charge to all these places is now 3f. To London the charge was originally 15f., it is now 5f.

A pneumatic tube, on the same principle as those used in London, will shortly be laid in Paris, between the telegraph stations at the Bourse, and the Ministry of the Interior, in the Rue de Grenelle. Telegraphic messages will be transmitted through this tube instead of by carts as at present.

THE RUSSIAN AMERICAN TELEGRAPH.—The progress of the work on the American-Russian telegraph is most satisfactory. The reports of the superintendent and his party, who have just returned from the summer's work, are very favourable. The route has nearly all been determined. A number of doubtful geographical questions of much importance to the location have been solved. Behring's Straits and the sea south thereof were sounded, and the shore examined, and both bottom and shore were found well suited for the safety of a submarine cable. New Archangel, St. Michael, St. Paul's, Petropaulowski, and the other Russian stations, were visited. The Russian officials everywhere received the expedition with great attention. The governor of Russian America, who is also director of the Russian American Fur Company, a very extensive and influential organisation, gave to Colonel Bulkley a circular instructing his subordinates to give him every assistance that he might want, even to furnishing him with men at his requisition.

CHEMICAL NOTES.

DEODORISATION AND DISINFECTION.—Dr. J. H. Barker, in his prize essay on "Deodorisation and Disinfection," sums up the results of several series of experiments in the following propositions:—

1. For the sick room, free ventilation, when it can be secured, together with an even temperature, is all that can be required.

2. For rapid deodorisation and disinfection, chlorine is the most effective agent known.

3. For steady and continuous effect ozone is the best agent known.

4. In the absence of ozone, iodine exposed, in the solid form, to the air is the best.

5. For the deodorisation and disinfection of fluid and semi-fluid substances undergoing decomposition, iodine is best (employed in the form of tincture).

6. For the deodorisation and disinfection of solid bodies that cannot be destroyed, a mixture of powdered chloride of zinc, or powdered sulphate of zinc, with sawdust is best. After this, a mixture of carbonic acid and sawdust ranks next in order; and, following on that, wood-ashes.

7. For the deodorisation and disinfection of infected articles of clothing, &c., exposure to heat at 212° Fahr. is the only true method.

8. For the deodorisation and disinfection of substances that may be destroyed, heat to destruction is the true method.

M. Gaudin, the eminent French chemist, states that by adding to iron, when in a state of fusion, peroxide of manganese and phosphate of iron, a degree of excessive hardness is acquired, which makes the metal especially valuable when used in machinery.

A very interesting experiment devised by Kraut is described in the *Annalen des Chemie und Pharmacie* for October. The author hangs a platinum spiral in an open wide-mouthed flask containing so much strong ammonia, that the liquid nearly reaches to the end of the spiral. Having made the spiral and the ammonia hot, he passes a stream of oxygen through the liquid. The active decomposition of the ammonia, which now takes place, soon brings the platinum spiral to a bright red heat, and the mixture of gases is exploded. The explosion reduces the temperature of the spiral for a moment, but the action proceeding, the wire is again made red hot, and another explosion is produced; and so on as long as the experimenter wishes. By introducing a very rapid stream of oxygen near the level of the ammonia, and close to the spiral, a continuous combustion may be kept up, producing the long-drawn sound which is heard when a jet of hydrogen is burned in a vessel of oxygen. In the first stage of this reaction before the ammonia is made hot, Kraut shows that the ammoniacal vapours are oxidized, and nitrous acid produced, which combines with undecomposed ammonia to form the nitrite.

PRACTICAL HINTS.

LACQUER FOR TIN.—Any good lacquer laid upon tin gives it the appearance of copper, or brass. It is made by colouring the varnish with turmeric to impart the colour of brass to it, and with annotto, to give it the colour of copper.

BRONZE VARNISH FOR STATUARY.—Cut best hard soap 50 parts in fine shavings dissolve in boiling water two parts, to which add the solution of blue vitriol 15 parts, in pure water 60 parts. Wash the copper soap with water, dry it at a very slow heat, and dissolve it in spirits of turpentine.

TO REPARE A VARNISH FOR COATING METALS.—Digest one part of bruised copal in two parts of absolute alcohol; but as this varnish dries too quickly it is preferable to take one part of copal, one part of oil of rosemary, and two or three parts of absolute alcohol. This gives a clear varnish as limpid as water. It should be applied hot, and when dry it will be found hard and durable.

VARNISHES FOR OIL PAINTINGS AND LITHOGRAPHS.—1. Dextrine 2 parts, alcohol 1 part, water 6 parts. 2. Varnish for drawings and lithographs—dextrine 2 parts, alcohol ½ part, water 2 parts. These should be prepared previously with two or three coats of thin starch or rice boiled and strained through a cloth.

TO VARNISH ARTICLES OF IRON AND STEEL.—Dissolve 10 parts of clear grains of mastic, 5 parts of camphor, 15 parts of sandarach, and 5 of elemi, in a sufficient quantity of alcohol, and apply this varnish without heat. The articles will not only be preserved from rust, but the varnish will retain its transparency and the metallic brilliancy of the articles will not be obscured.

GLEANINGS FROM SCIENTIFIC WORKS.

SINGLE rivetted joints are about one fifth weaker than the original plate. This does not include the loss due to the metal punched out.

IODINE is almost entirely wanting in young sea-weed, and it has reached its maximum quantity when the plant is thrown off in drift.

LIEBIG states that 40 lb. of finely ground bones contain 22 lb. of pure phosphate, and are the best agents to supply phosphate to the soil.

THE name of the mineral jet is said to be derived from Gages, a river of Lycia, whence the ancients derived their supply of this substance.

Mr. FAIRBAIRN's experiments showed that the strength of a double rivetted, as compared with a single rivetted joint, is as ten to eight nearly.

FROM drawings in the Egyptian tombs, and from objects found in them, it appears that expert glass blowers abounded in Egypt 2,000 years B.C.

IN 1822 the principal railways, or rather trams, in Wales, were the Cardiff and Merthyn, 26¼ miles long; the Caermarthen, and the Swansea line.

IRON canal boats were first made about the commencement of the present century. There is evidence of their existence in Staffordshire in 1812 and 1813.

THE result of the analysis of the Taranaki iron sand is as follows:—88.45 peroxide of iron, 11.43 oxide of titanium with silica, and only 0.12 waste in one hundred parts.

FROM Professor Airy's pendulum experiments at Harton Colliery, the mean specific gravity of the earth is found to be 6.566.

THE Siberian plumbago differs considerably from that obtained in Cumberland, inasmuch as it is almost impossible to erase the marks of the former by India-rubber.

IT requires as many as 2,000 tons of coal to produce a small circular block of aniline, 20 inches high by 9 inches wide. This quantity is sufficient to dye 300 miles of silk fabric.

ONLY 60 parts by weight of charcoal are required to produce 100 of Austrian charcoal iron. The ore is a brown decomposed spathose ore, containing when roasted 52 per cent. of iron.

IN 1850 the value of the steam engines exported from Great Britain was only £423,977, and of the general machinery £618,189; while in 1860 the respective values were £1,238,333 and £2,599,488.

BY means of the machine for microscope writing, invented by Mr. Peters, it is stated that the word "Matthew Marshall, Bank of England," can be written in the two and-a half millionth of an inch in length.

THE French Exhibitions or National Expositions date from the year 1797, when the first was held in the palace of St. Cloud, with the object of reviving the industrial resources of France, which had suffered much during the revolution.

PLANTS living in running waters, or in large collections of water capable of being agitated by the wind contain more iodine than those growing in stagnant water.

WHEN Mahomet II. besieged Constantinople in 1453, he made use of cannon throwing stone balls of 1,200 lb. weight. They could not be fired more than four times a day.

IN determining the velocity with which light travels through leaves of various metals, Mr. Quincke found that it travels faster through gold and silver than through a vacuum.

THAT cotton paper was in use in the eleventh century may be inferred from the year 1050 being the date of a manuscript written on cotton paper, and preserved in the Imperial Library at Paris.

INDIA-RUBBER was first introduced into France in 1776. Dr. Priestley says that in 1791 he saw a specimen of the gum at a stationer's, where it was used to erase pencil marks; hence its name.

THERE are sometimes a succession of north and south poles in the same bar magnet. A bar of the kind can easily be produced by softening certain portions of its length by the aid of the blow-pipe.

FROST-BITTEN potatoes are sweet from the spontaneous conversion of their starch into sugar. The same effect takes place when potatoes sprout in the spring, and they are consequently of less value as food.

THE manufacture of soap in London first began in 1524, before which time the city was supplied with white soap from abroad and with grey soap, speckled with white, from Bristol which was sold for a penny a pound.

THE joints of an iron rivetted beam have sustained upwards of 3,000,000 changes of one fourth the breaking weight without injury. The beam broke with 315,000 addition changes when loaded to one-third of the breaking weight.

IN every twenty-four hours the electrical condition of the atmosphere twice increases and decreases in strength, and is weakest between twelve and four; but heat and cold always cause considerable variation.

IN 2,422 observations different persons were 252 times externally positive in electrical state, 771 were negative, and 339 imperceptible. In sitting at rest, Hemmir found himself 332 times positive, 14 negative, and 10 times imperceptible.

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ON PURE WATER.*

By EDWIN LANCASTER, M.D., F.R.S.

(*Continued from page* 213.)

Now let us see if we can in any manner account for the presence of matter in water which can exert such an injurious influence on the system. If we take four or five pints of water and allow it to stand for a few hours, and then decant off the clear part, leaving a small portion behind, say from two drachms to an ounce, and then place a drop or two of this remaining portion under the microscope, we shall find we have a variety of living beings. They are chiefly unicellular organisms belonging to the animal and vegetable kingdoms. The number and variety of them will give an approximation to the impurity of the water. They are of different kinds, and where the filaments of fungi and certain forms of animalcules abound there the water may be regarded as most impure. As a test example, sewer-water may be taken, and when similar organisms to those found in sewer-water abound, the specimen examined is to be most suspected. In making this investigation care should be taken to have fair samples of the water. The purest water, if exposed for a long time to the air in close vessels, or taken from pipes or cisterns which have a long time been exposed to the air, will present these organisms. The only fair way of using this test to take a specimen of the water from the mass of the water in the river, reservoir, or other source from which the water is obtained. The purest water, even distilled water, when kept for a length of time exposed to the air, will contain the filaments of fungi and a variety of animalcules Under any circumstances, living organisms can only be regarded as indicating the probability that water in which they are found contains organic impurities, which by their decomposition have afforded the elements on which the lower plants and animals are nourished. That they are more abundant in water contaminated with sewage and other organic impurities shows the importance of using the microscope as a test of the purity of water.

It is, however, the death of these living organisms and the introduction into water of animal and vegetable matters in a state of decomposition that renders water impure and dangerous to the health of those who drink it. Both river and spring waters are liable to these contaminations. In recent times our rivers have been rendered impure by making them common sewers of the great towns and cities situate on their banks. It is in this way the Thames has become polluted, so that the legislature first interfered and required that all water companies supplying London should obtain their supplies above Teddington Lock, beyond the influence of the sewage of London, and subsequently passed an Act for the carrying of all the sewage of London down to a point in the Thames in which it could not be brought by the tide into the river as it passed through London.

It must not, however, be supposed that all organic matter produced in rivers or thrown there remains unchanged. No sooner is organic matter placed in water than a process of oxidation commences, by which the nitrogen of the organic matter is coverted into nitric acid, and the carbon into carbonic acid. This is effected by the oxygen, which is naturally found in all water exposed to the air. As long as there is sufficient oxygen in the water to oxidise the organic matter, so long the water remains free from those constituents which are injurious to health. It too often happens, however, that all the oxygen is exhausted and the organic matters enter into a state of change in which dangerous compounds are generated. What the nature of these compounds is, neither the chemist nor the pathologist has been able to demonstrate. It is, however, well known that water under these circumstances becomes tainted; that it gives off sulphuretted hydrogen and other stinking gases: and that, when taken internally, it produces sickness, diarrhœa, and other symptoms of disease. It does not follow that these conditions will occur at all times. In cold weather water holds more oxygen in solution than in hot weather, and it frequently happens that it is only at certain seasons that water holding organic matters in solution becomes injurious. Heat not only robs water of its oxygen, but favours the rapid decomposition of animal and vegetable matters, so that it is most frequently during the warm season of the year that water becomes injurious.

How to detect dead organic matter thus becomes a matter of great importance. Now, it has been found that this matter exists in water in two forms —suspended and dissolved. The suspended organic matter can be detected with the microscope. It is generally heavier than the water and settles at the bottom, although sometimes it floats on the surface. In either case it may be detected by the microscope, and is found to consist of minute, shapeless particles of animal and vegetable bodies. When these are in any appreciable quantities, the water is impure.

When the organic matters are in a dissolved state, the microscope can no longer detect them. Chemical agents must be employed for their discovery. The method adopted by analytical chemists is to weigh the total solids of the water left by evaporation, and then to incinerate the portion left, and to weigh again. The matter lost by incineration is then regarded as organic matter. There is, however, another method, which, although less accurate, is easily applied, and requires no chemical knowledge to use and appreciate. This process consists in adding a quantity of permanganate of potash or soda to the suspected water. All the permanganates have the power of giving a beautiful purple colour to water. A small quantity of organic matter will, however, decompose the permanganate and prevent its colour from being developed, or annihilate it if it has been once established. The best method of procedure in this case is to employ a solution of permanganate of potash of a known strength. I employ a solution of five grains to the ounce of distilled water. Half a pint or a pint of the water to be examined may be then taken, and five drops of the solution of permanganate added. According to the colour left in the water will be the amount of organic matter it contains. The quantity of permanganate may be so arranged as to give an approximation to the quantity of organic matter in the water when such a quantity of permanganate has been added as to afford the slightest possible tinge. If a large quantity of permanganate has its colour thus destroyed, a large quantity of organic matter must be present. But for ordinary testing it is better perhaps to have a standard water,—pure distilled water, or some water whose quantity of organic matter has been ascertained,—and then compare the colour it gives with the permanganate with the colour given by the suspected specimen of water.

By this test the impurity of water from dissolved organic matter can be ascertained with very tolerable accuracy. It should, however, be recollected that it is not applicable to water containing iron, as a very small quantity of iron will discolour the permanganate. The quantity of organic matter in waters supplied to our great towns differs from one to three or more grains per gallon. Suspicion should be aroused when the organic matter of water reaches two grains per gallon.

Having said thus much with regard to the nature of water and the means of ascertaining its impurities, the question may be still dealt with a little further as to the nature of the evils produced by drinking impure water. I have more particularly referred to cholera, and the evidence of a large number of other cases is most convincing as to the production of cholera by impure water. It is a question to be determined as to whether any specific cholera poison is conveyed into water which thus gains access to the individuals attacked, or whether the organic matter of the water is in such a state as to bring on a state of the system in those who drink it to predispose them to receive the poison of cholera from other sources. At any rate, our sanitary action in this case should lead us to cover both issues of the question, and protect ourselves from the direct poison of the water as well as its predisposing action.

With regard to other diseases of the bowels, there is abundant evidence on record to show that diarrhœa is produced by drinking impure water, and that such cases of diarrhœa have only ceased when pure water has been had recourse to for drinking and cooking purposes. The organic impurities are much more likely to produce this effect in warm weather, for reasons I have before alluded to; and this is the reason why diarrhœa is so much more frequent in summer, and why water should be much more carefully watched in the warm seasons of the year.

(*To be Continued.*)

* From the *Popular Science Review*.—Robert Hardwicke, Piccadilly.

ELECTRICITY.

The highly electro-positive metal magnesium would be invaluable to electricians if it could be got for the same price as zinc; already it is being proposed for use in certain electrical apparatus, and at a recent meeting of the French Academy, M. Bultinck presented a note on the Use of Magnesium in Voltaic Piles in place of Zinc. The author shows that a short chain of twenty elements, each composed of thirty-five millimetres of thin silver and magnesium wires, wound about pieces of caoutchouc and properly connected, will produce all the effects, chemical, physical, and physiological, of a long Pulvermacher's chain, when simply moistened with pure water.

It is announced that the two lighthouses at Havre, will now be definitely illuminated by electricity, that all difficulties in the way of producing a constant light by induction machines have now been overcome by the Alliance Company. The machines will be driven by a six-horse power locomotive engine, which will also compress air for whistles or trumpets to be used as fog signals.

M. Duchemin proposes to construct Ampere's electric boat upon a sufficiently large scale, and to use it as a warning buoy on shoals, &c., he proposes to float, by means of cork, a carbon cylinder within a hollow cylinder of zinc, the connecting wire to be made to strike a bell in the usual way. He speaks of small cylinders, but gives no suggestion as to the the size necessary to operate a bell large enough to be heard at any distance.

PHOTOGRAPHIC NOTES.

BLISTERS IN ALBUMENIZED PAPER.—A correspondent says:—"I have been in the habit of floating my albumenized paper upon a 70 grain silver bath for from four to five minutes at night. Next morning they generally had a yellowish or creamy tinge; printed well, toned slowly, and blistered awfully as soon as put into the hypo, the marks of the blisters showing darker than the rest when finished. I now float on a bath of the same strength for seven minutes, and the paper keeps quite white, tones quicker, and the blisters have disappeared."—*Photographic News.*

WINDOW FOR THE ILLUMINATION OF A PHOTOGRAPHER'S DARK ROOM. — Obernetter mixes an acid solution of sulphate of quinine with some gum or dextrine, and paints the mixture over a thin sheet of white paper. With this he covers the window panes, and he states that on the brightest day a window so prepared will allow no actinic light to pass.—*Berlin Photograph Mitheil,* No. 16, 1865.

PHOTOGRAPHING ON PAINTERS' CANVAS.—Coat the surface with collodio-chloride of silver, expose under a negative in the usual way, and tone and fix as a paper picture. Of course, after the printing is completed, the canvas can be stretched upon a frame for use in the ordinary way. Care should be used in selecting a suitable sample of collodion. If it be of the tough and horny kind, it will be liable to leave the canvas, and spoil the work, when it is, perhaps, completed. But if it be of the kind distinguished as giving a powdery film, it will adhere with perfect tenacity, and can only be removed by the use of a solvent. If the ground be laid with a mixture of wax and resin, as in Truchelut's process, when the photograph is completed, the wax on being melted by heat will suffuse the whole picture, which thus becomes bedded in the ground, and the danger of peeling off is removed.—*Year Book of Photography.*

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BALLOON ASCENTS.—I.*

Illustrated on Page 254.

Long years ago an ingenious mechanic—the first to work the stereotype process in Scotland—which he did in the University Printing-office in Thistle-street, Edinburgh—who could not see his way very clearly to a balloon, speculated on a pair of wings, on which he bestowed much care and elaborate preparation, intending as he did to soar—where, he was not exactly certain. To true genius courage of a high order is a close attendant, and Mr. Howe had enough for a regiment of Highlanders. At length the wings were finished, fixed on, and fluttered in the back yard; they operated in a leap from the dust-bin, hence it was reckoned they would operate well in a flying leap from the Castle wall. There, one day, he betook himself, mounted his wings on the parapet, flew off, and—O horror!—came down flat to mother earth, to the injury of his limbs and science. One of the poor man's legs had a twist ever afterwards. The fate of poor Mr. Howe's scheme has not deterred many from following his flight and coming to grief. But the balloon seems to have enjoyed the most favour for venturous spirits, and, if sculpture lies not, in the days of Nineveh there were flights of balloons. For, doth there not exist stone pictures from that long-hidden city on which are represented a whole convoy of single-decked aerostators! Of course there is; and so, if Tennyson's dream of merchantmen careering through the air be ever facted, why, it will only be to prove—if the sculpture can be relied on—that there's nothing new under the sun.

Coming back to more modern days—Nineveh in the reckoning—in the days of Lord Bacon, aerostation occupied some attention, though the attributing the idea of the balloon to that philosopher is a mistake. In 1670, one Borelli had something to say on the matter, and he, to his own satisfaction, refuted the idea that man could take unto himself the wings of a bird and do more than flop. In 1766, Mr. Henry Cavendish ascertained that hydrogen gas, used in ballooning, is at least twelve times lighter than common air, and in 1782 the true doctrine of aeronautics was announced in France by the brothers Montgolfier. On the 15th of September, 1784, Signor Lunardi made the first attempt in England to navigate the atmosphere, taking his departure from Moorfields. In the year following, Blanchard and Jeffries started from Dover and passed over the Channel to Calais, and a "rise" was made from the Ranelagh Gardens, Dublin. Afterwards Mr. Arnold went up from St. George's-in-the-Fields, and pitched into the Thames; and Major Money went up from Norwich and fell into the North Sea. Luckily for the rash major the mishap was noticed from the deck of a revenue cutter, and he was picked up very wet but not much hurt. Passing on to 1812, we find a person named Sadler falling from his balloon into the sea near Holyhead, from whence he was rescued. Thirteen years afterwards, Sadler, junior, falling from his balloon, was killed; and in the year preceding Lieut. Harris met the same fate. On July 24, 1837, Mr. Cocking ascended from Vauxhall to try his parachute—in the descent, which was pluckily made, the parachute collapsed, and so did Cocking; when picked up he was dead. Mr. Green about this time achieved great notoriety by his ascents; on Nov. 7, 1836, the great Nassau balloon started from Vauxhall "on a wind" for a trip, with three persons on board, and after having been in the air for 18 hours, descended at Weilburg in the duchy of Nassau. Previous to this, in 1828, Mr. Green ascended from London on a horse attached to a balloon, and he repeated this cruel joke on a pony in July 1850; starting from Vauxhall. The honours of this sort of equitation belong however, to M. Poitevin, of Paris, who, in 1858, was nearly drowned in the sea near Malaga while descending from his balloon. Lieut. Gale, an English officer, ascended in 1850 from the Vincennes hippodrome, with a horse in tow. On descending and detaching the animal from the balloon, the people let go the rope too soon, and away went the balloon with the lieutenant. Next morning he was discovered on the ground dashed to pieces; the balloon in tatters about a mile from his remains. Most of the London folks remember the disgraceful ascents of Mdme. Poitevin, from Cremorne, on a bull attached to a balloon, and the parties appearing before the magistrate at Bow-street, for cruelty to animals.

But all this time no contribution had been made to science by aeronauts, and it was not until 1858, that Mr. Walsh made some ascents for meteorological purposes. Their repetition was recommended to the British Association in 1860-61, and in 1862 the king of aeronauts, Mr. Coxwell, steered Mr. James Glaisher up into the ethereal vault in a balloon provided with apparatus. The ascent was made from Wolverhampton, on July 17, when a height of five miles was attained. The two gentlemen have often gone aloft in company, (twenty-five times in all, we believe), since then; and on the subject of his investigations and results, we will now leave our intrepid philosopher to speak:—

"It will be convenient here to speak of the subjects of research by means of balloons with which I was charged.

"The first in importance was the confirming or otherwise the result obtained from the observations on mountain sides, on the decline of temperature with increase of elevation—viz., the lowering of temperature of the air 1° for every increase of elevation of 300 feet.

"The next in order of importance was the law of the distribution of the water in the air, in the invisible shape of vapour, near the earth, near clouds (but below them), in different kinds of clouds, and at high elevations above the clouds. These determinations to be made by the use of different instruments—viz., by Daniel's hygrometer, Regnault's condensing hygrometers, by dry and wet bulb thermometers, or ordinarily used, as well as when under the influence of an aspirator, so that considerable volumes of air could be made to pass over both their bulbs at pleasure.

"To compare the results thus found together: firstly, to determine whether Daniel's or Regnault's hygrometer were the better instrument; secondly, to compare the results as found by the use of the dry and wet bulb thermometers, as in common use, with those under the action of the aspirator; thirdly, to determine what confidence could be placed on the use of the dry and wet bulb thermometer at high elevations, but particularly up to those heights where man may be resident, or where troops may be located, in the highlands and plains in India.

"To determine the effects which the sun produces upon delicate thermometers, exposed to its full influence, at different heights, in excess above the readings of equally delicate thermometers protected from the direct beams from the sun; and also the effect the sun exercises on the readings of Herschel's actinometer, at different heights, when fully exposed to his rays at different elevations, in comparison with the increase of readings in the same interval of time when on the ground.

"To determine whether the solar spectrum, when viewed from the earth, and when examined far above the earth, exhibited any difference; whether there were more or less black lines crossing it; whether these lines were better defined or not; and whether, towards sunset, there was any increase in the number of these lines.

"To compare the readings of mercurial barometers and aneroid barometers together; to determine the electric state of the air; to determine the oxygenic conditions of the atmosphere by means of ozone papers; to determine the intensity of magnetism; to collect air at different elevations; to note the kinds of cloud; their heights at their lower and upper surfaces; their density, &c.; to collect information about the currents of the atmosphere; to make observations on sound; to make physiological observations; to note atmospheric phenomena in general. . . . . .

"The kind of instruments used, and their arrangement in the car of a balloon, are shown in the illustration, as prepared for observation.

"Near one end of the car was placed a board or table, the extremities of which rested on the sides of the car, and were tied to it. Upon this board were placed suitable frameworks to carry the several instruments, arranged as shown in the Plate. At the extreme left hand (1) is shown a blackened bulb thermometer with its bulb in a vacuum tube; just above it (2) is placed a very delicate blackened bulb thermometer—both these instruments were exposed to the full rays of the sun; at (3) and (4) were placed delicate dry and wet bulb thermometers, these instruments were covered with double highly-polished silver caps, in the form of a frustum of a cone, open both at top and bottom; that for the dry bulb is shown at (5), being removed to show the form of the bulbs of these thermometers; that for the wet bulb is placed *in situ*. At times, additional protection was applied to these instruments. From the wet bulb (4) the conducting thread is seen passing from the muslin covering the wet bulb beneath the silver cone to the water vessel (6), from which water was conveyed to the wet bulb thermometer.

The next instruments in order are a similar pair of dry and wet bulb thermometers (7 and 8): these were inclosed in two silver tubes placed side by side, and connected together by a cross piece joining their upper ends, and over both were placed double shades with spaces between them (not shown in the Plate), as in the other pair of thermometers. In the left-hand tube was placed the lower end of the stem and bulb of the dry thermometer; and in the right-hand tube, the same parts of the wet bulb thermometer; towards the lower end of the left-hand tube there was an opening; by means of the aspirator, to be spoken of presently, a strong current of air was drawn in at this aperture, then passed the dry bulb, in its upward passage into the small horizontal tube, and from thence into the right-hand tube, passing downwards over the wet bulb, and away by the flexible tube to the aspirator under the table. Near to these instruments was placed a watch or chronometer (9) adjusted to Greenwich time, resting on the table, but hanging to a hook in the framework. The next instrument on the framework was a Regnault's hygrometer with a single silver cup (10), with a tube leading from it with a glass terminal of sufficient length, that when blowing into it by the mouth, any other instrument, at any part of the table, could be read. Next to this instrument was the mercurial barometer, a perforation being made in the table admitting its lower branch to descend below (11), leaving the upper branch (12) at a convenient height for observing, with respect to the other instruments. Near to this instrument was placed a large aneroid barometer (13), its lower part resting on the table, while its upper part was fixed to the framework; above this instrument, placed on the framework, was a second Regnault's hygrometer (14) with a pair of gold cups; in the lower part of its central supporting stem there was an open projecting pipe, with flexible tube attached, leading to the aspirator below. A Daniel's hygrometer (15) occupies the next position, conveniently placed for inversion with the right hand, and admitting a ready perception of the first appearance of dew, being nearly central among the instruments; beyond these are placed two exceedingly delicate thermometers, the one with a spiral bulb (16), and the other with a gridiron form of bulb (17); beneath these, resting on the table, are two spectroscopes (18 and 19), and at the extreme right hand (20) Herschel's actinometer; on the table, besides, is a lens with bottles of water and æther. Beneath the table the aspirator (21) was fixed, near the centre of the table, so as to be conveniently worked by the hands, by taking hold of both sides, or by the foot resting on the trestle beneath. Holes were cut in the board to admit the passage of the flexible tube from the dry and wet bulb thermometers and the flexible tube from Regnault's hygrometer, previously referred to, both of these tubes being furnished with stop-cocks (22 and 23).

* The major part of the matter of this article is extracted from a paper in the *Popular Science Review* by James Glaisher, F.R.S.; the illustration is also from the same source.

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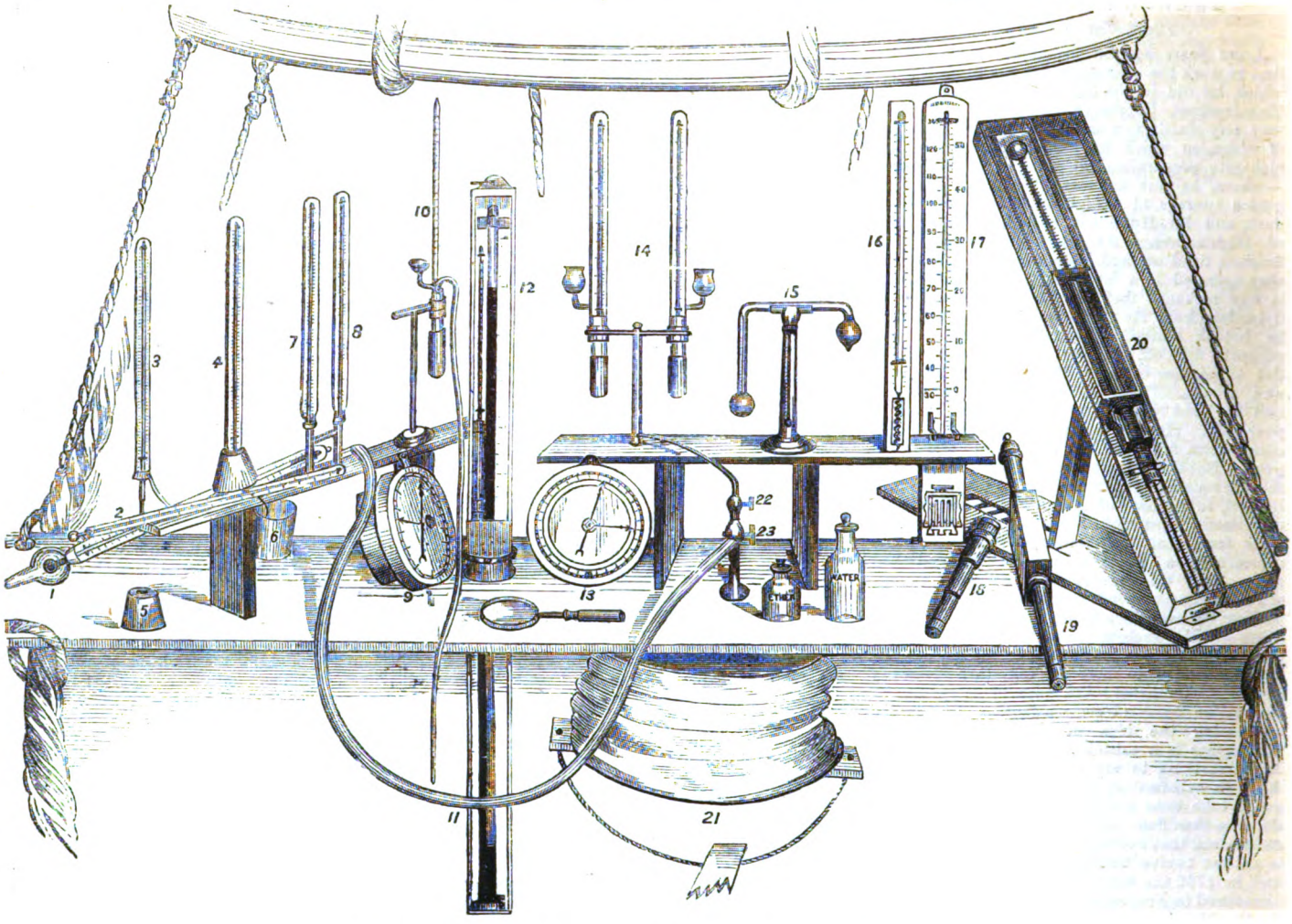

ARRANGEMENT OF INSTRUMENTS IN CAR OF BALLOON.

"Whilst this operation was proceeding, the readings of other instruments were taken and recorded till the time approached when undivided attention was required to the right hand gold cup of instrument 14, in comparison with its left-hand gold cup, to note the first dimming of the bright surface of the former by the deposition of moisture upon it, then to cease working the aspirator to read both the instruments of 14 and then to read instruments 7 and 8.

"The mercurial barometer employed was a Gay-Lussac's siphon. The inner diameter of its tube is ¼ of an inch. The graduations were made on a brass scale from its middle point upwards and downwards; each division was about 0·05 inch in length, representing twice that value; so that an observation of either the lower or upper surface of the mercury would give the approximate length of the column of mercury.

"The barometer was furnished with its own thermometer, whose bulb was immersed in a tube of mercury of the same diameter as that of the barometer. The readings of this thermometer frequently read from 30° to 40° in excess of those of the sensitive thermometers.

"The bulbs of the sensitive thermometers were long and cylindrical, being about ¾-inch in length, and one-twelfth inch in diameter. The graduations extended downwards to minus 40°, and were all on ivory scales. These thermometers, on being removed from a room heated 20° above that of an adjoining apartment, acquired the temperature within ½ a degree in 10 seconds; but on taking the thermometer back to the heated apartment it took nearly double the time to rise to within ½ a degree of the true temperature. They were sufficiently sensitive, therefore, for my purposes, and no correction ordinarily is needed for sluggishness except only when the balloon was moving with great and unchecked rapidity.

"Besides the instruments shown in the illustration, there were ozone papers pinned to the table and to the cordage near, a compass, magnetical instruments, my note-book, &c. My position was in the front of the table, almost equidistant from the extreme right and left instruments.

"The successful working of these instruments depended very much, as I have before said, on their arrangement, a quick eye, and the orderly habit of a trained observer; the arrangements of reading of every instrument, and of every subject of investigation were such that the one constantly checked the other; any erroneous reading of the dry bulb thermometer, for instance, was shortly detected by the reading of differently graduated, spirit, or gridiron bulk thermometers, and any systematic error in the reading of the wet bulb thermometer was checked by the observations of the hygrometers, whose readings, though related, were very different. Thus the arrangements included a system of checks, so that it was not possible to continue erroneous readings, when either the instruments needed attention, as the wet bulb requiring more water, or the water not frozen on it when it ought to be, or still frozen when it ought not to be (in the latter case requiring the immediate application of heat, the only source of which in the balloon is the mouth), or from the painful state of the observer at times, losing to some extent the power of accurate observation. These arrangements were necessary, the situation of an observer in a balloon being so peculiar, and there being no means afterwards o discovering erroneous observations, if not discovered at the time, or the means of discovery be included in the arrangement of the series of observations. It remains to mention that the arrangements must also include that every instrument be screwed down to the table or framework, so that no lurching of the balloon, no vibration of the car from dropping the grapnel, and no accident, can displace them; everything else must be tied with rope of sufficient length for use and safe when out of use; for instance, the lens, which comes into active use when at high elevations, where the eye loses some of its power, must be fixed to cordage near the right hand with string of sufficient length that it can be directed to any instrument; in fact, every instrument must be screwed down if to be kept firm, and everything else tied, and all so arranged as to be readily removeable. . . . . .

"In every ascent the series of observed temperatures, when compared with the calculated temperatures at the rate of 1° decrease for every 300 feet, were found to be very different, and that these differences, with different ascents, when compared, did not agree. The most marked differences, in this respect, were found dependent on the state of the sky, which exercised a great influence, and the experiments had to be divided into two groups, one with clear or nearly clear skies, and the other with cloudy skies; the decline of temperature being the more rapid with skies free from cloud.

"I will first speak of the results with cloudy skies as based upon all the experiments under those circumstances."

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THE LATHE AND ITS USES.*

III.

It is most important that the ends of a rod or shaft should be squared up first before the body is turned, for the removal of some slight inequality subsequently may cause the whole shaft to run out of truth. The centre must be drilled with a small drill and slightly countersunk. When the end is squared up, the centre must be run back a little so that the tool point may project over the drilled hole, and thus make it all true about the centre, as in

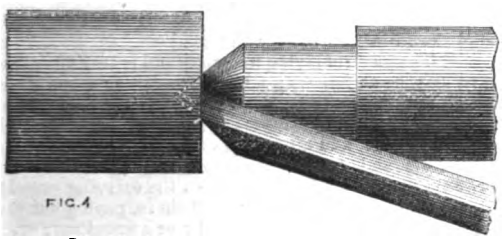


FIG. 4

Fig. 4. This will make the work push over to one side of the centre, but that is of no consequence. Let it run as it will; so long as it does not come out of the centres, there need be no apprehension.

Here is another kind of roughing tool to do heavier work with.

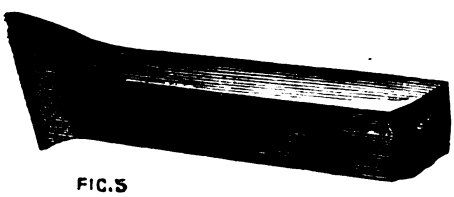
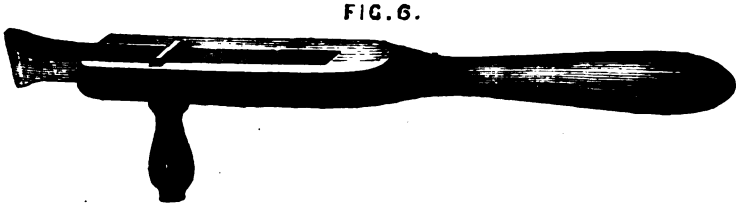


FIG. 5

There are two kinds of tools used in foot lathes, called straight and heel tools. This is a heel tool.

FIG. 6.



It is so called from the heel which is forged on the lower end. One form of the straight tool has already been shown. The heel tool is used on

FIG. 7.

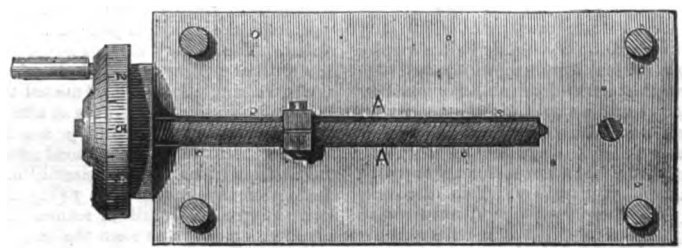
heavy work, and the object of it is apparent, namely, to hold on the rest and so impose but little labour on the workman to retain it in place, or prevent it from receding. It is generally forged from half inch or five-eighth steel. The steel is held in a handle twenty inches long, grooved on top to fit the steel, and furnished with a handle at right angles. This handle has a square eye in the top that the tool passes through. A nut at the end of it screws up the eye and binds the tool fast in the groove so that it cannot slip.

Here it is complete in Fig. 6. The lower handle enables the workman to have great power over the edge and to direct it from or to the work without danger of catching. The tool is used by resting the end on the shoulder, as in Figure 7, and turning the lowest handle. Since the heel holds the tool from slipping, there is no occasion to bear against it. In fact, there is no occasion at any time to force the tool from the workman, but it must be turned sideways, back and forth. A piece properly centred may be cut in any way without destroying its truth.

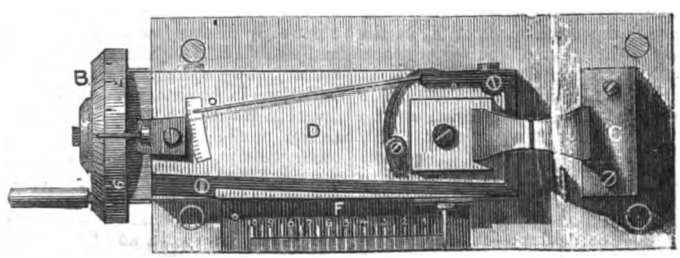
* Mostly compiled from *American Journals*

HORSTMANN'S GAUGE.

ATTENTION has been frequently directed in this journal to the subject of gauges for measuring wire, sheet metal, &c., and various suggestions have been made to us respecting the attainment of



uniformity in numbering and gauging. The most practical of all is that forwarded to us by Mr. Horstmann, of No. 3, Bladud's Buildings, Bath, which we have illustrated from a beautiful little model he kindly forwarded to us for inspection. He states that he has had it in use for six years, and would like to see it in general use: its being



a parallel gauge, and measuring to the 1-10,000th part of an inch, is valuable to him in his business of watch and clock maker. The long screw A is cut in 100 threads to the *standard* inch. The nut on the wheel B, fixed to the long screw A, is again divided into 100 parts; consequently, each division on the nut B is the 1-10,000th part of an inch. The jaw C is a fixture; D is the slide, which is moved by the long screw A. The jaw E, affixed to the slide D, is moveable, to prevent delicate parts in watchwork being crushed. The division plate F is the index-plate, to show the number of turns the screw A has made. The moveable jaw C actuates the small hand affixed to the side of the slide, and which travels over the index shown. The illustrations sufficiently explain the uses of the gauge to those who require such. We take this opportunity of thanking Mr. Horstmann for his kindness, and to compliment him for the neatness and finish of his work. We have tested it with various Nos., and found it true to a "breath."

BRITISH GOLD.

By ROBERT HUNT, F.R.S.*

(*Concluded from page* 233.)

Our readers will be familiar with the amalgamating process, by which gold is separated from the earthy minerals with which it is mixed. The extraction of gold by amalgamation is, however, attended with serious difficulties. Whenever Sulphides, Arsenic, Bismuth, or Tellurium are present with the gold, they frequently tarnish the metal, and the mercury cannot act upon it. Technical language informs us, that the mercury "sickens," that is, it grows thick, or that it "flours," meaning that it becomes pulverulent. These conditions are dependent upon the presence of other metals. Under either of those circumstances much of the gold escapes the influence of the mercury and is lost in the "tailings," whilst much of the mercury itself is carried off in the washings. Mr. William Crookes, F.R.S., the discoverer of the new metal Thallium, has introduced an improvement, which promises to be of the utmost advantage, in all our operations for obtaining gold in quartz-mining, or when it is combined with other minerals.

Mr. Crookes's process posesses the following important advantages:—By the judicious admixture of a certain proportion of sodium with the mercury its amalgamating powers are, under all circumstances, preserved and intensified. It will extract gold from Sulphides, and from such other minerals as have hitherto resisted the ordinary process. It will seize upon gold tarnished by any of the metals named above, and which would pass untouched through common mercury and be lost. It will absolutely prevent "sickening" and "flouring," consequently the yield of gold is augmented, and a large saving in mercury is the result.

A series of experiments were made to determine the action of the sodium, under such circumstances

* Extracted from the *Quarterly Journal of Science* for October. Churchill and Sons.

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as presented unusual difficulties, and the results of these trials were as follows :—

It should be stated that the mercury contained one per cent. of sodium.

1. When a little of the sodium amalgam was added to ordinary mercury, the affinity of the latter for gold was greatly increased, so that when pieces of gold were dipped into it they were instantly covered with mercury, although when dipped into mercury to which no sodium had been added, amalgamation was very slow, and difficult to obtain.

2. "Floured" mercury immediately ran together into a single globule, on the addition of a little sodium amalgam.

3. When iron pyrites (bisulphuret of iron), magnetic iron pyrites (sulphuret of iron), or copper pyrites (sulphuret of copper and iron), were triturated with sodium amalgam, the pyrites were decomposed, and on the addition of water, a black precipitate of sulphuret of iron was obtained.

4. Triturated with sodium amalgam—*a*, Arsenical pyrites was decomposed and arsenic amalgam formed ; *b*, Galena (sulphuret of lead) was decomposed, and lead amalgam formed ; *c*, Blende (sulphuret of zinc) was decomposed and zinc amalgam formed ; *d*, Litharge (oxide of lead) and white lead (carbonate of lead) were decomposed and lead amalgam formed. An extensive series of experiments has been made at the mines near Dolgelly, and in every case, a considerable increase in the quantity of gold has been effected by the use of the sodium amalgam. The only thing which appears to be necessary to ensure the usefulness of the sodium amalgam in all cases, is a preliminary experiment to determine the quantity of sodium which should be used with the mercury. When too much sodium is employed it attracts the other metals present—in some cases to the rejection of the gold ; but when judiciously applied it works with wonderful facility. This discovery promises many advantages to the adventurers in the auriferous mines of Wales, and it will probably lead to the successful working of some of the poor quartz lodes through which the sulphides and arsenides of the baser metals are disseminated, and thus prove a solution of the problem, Can British gold be worked with commercial advantage ?

VAN CHOATE'S SUBMARINE TELEGRAPHY.

II.

It is stated that the two wheels C, C, are arranged and supposed to be turning at the same time and speed, having started at a corresponding similar point, and that the wheel at the sending station has brought one of its projections in contact with the other point at *d*, and that the space *e* is also temporarily closed. Now suppose at precisely the same instant wheel C, at the receiving station, should bring one of its metallic projections in contact with the end of the conductor at *g*, this would complete a perfect metallic conductor from the sending station to the receiving station, whereby the electric current might complete its circuit from battery B (sending station) to battery B (receiving station), and through the earth or water E, as the case may be, in the direction of the arrows back to the starting point. A repetition of the current would pass through this circuit, while the space *e* (sending station) was kept closed as often as the projections of the two revolving wheels C, C, synchronously came in contact with the proper mechanisms and closed up the two spaces *e* and *g*.

As to the function and operation of the sending or manipulating key or device :—In order that the synchronous closings of the open spaces *e* and *g* (Fig. 5), and the consequent passage of the electric fluid through the circle may be practically utilized for telegraphic purposes, it is necessary that the key *h* (sending station) should be arranged in connection with the other parts of the mechanisms, so that it should correspond by proper contrivances with a certain signal of the indicator. Suppose the device *h* so arranged that when depressed or moved the space was closed at *e* when the signal representing the letter A arrived at a certain point or place ; there being but one letter or signal A for each revolution of the revolving wheel *c* it would show that at every revolution of the wheel C the same letter A would appear at the same place. As the sending and receiving revolving wheels C,C, and signal mechanisms exactly correspond, and both wheels start at the letter A and revolve in the same space of time, the same letter would arrive at both stations at a corresponding point at the same time. These points and times corresponding exactly to the depressed key or moved lever would consequently produce closings of the spaces *e* and *g*, and the electric fluid would also pass through the circuit at the same instant, producing the effect at the receiving apparatus, which would notify the clerk of the corresponding signal or letter at that moment in unison with the depressed key or lever at the sending instrument, and also the character or letter corresponding to the one indicated by his own receiving apparatus. A sufficient number of these keys or levers are arranged in this manner to correspond with and represent the signal alphabet. To produce the various signals, characters, or letters, the same repetition of movement is performed.

The important feature in this invention thus arranged (Fig. 5), consists in the fact that the circuit at the receiving apparatus is mechanically and perfectly disturbed at certain intervals.

The wire or conductor is kept free from all influences of return currents, circuits, &c., and all "principles of Leyden jar," &c., are entirely obviated. The battery current never passes upon the line until at the instant of closing the spaces *e* and *g*, when a single flash is transmitted through a conductor free from all influences of abnormal circuits, as the open spaces *e* and *g* are in both cases between the battery and the conductor or cable, and the intermissions of the circuit, or breaks and closings of the spaces *e* and *g* (Fig. 5), are so short that the ground circuit or return currents do not have time to set in or form the clear metallic conductor transmitting the instantaneous flash in much less time than it takes for the ground or abnormal circuits to form. Mr. Van Choate claims that his apparatus is capable of producing these disturbances of the circuit, breaking and closing at the rate of fifty-eight in a second, and may be increased to a much more rapid speed. The letters of the alphabet may be printed through cables at this rate if an operator can be found so expert as to finger the keys correspondingly. In order to write or operate back from the other side it is only necessary to close the key *h* at *e*, and open and manipulate the key *f* at the other end.

The second feature of the invention is the apparatus and manner of operating lines and cables at least twice the distance that can possibly be done by any other system.

In Fig. 6 will be seen precisely the arrangement and apparatus described and shown in Fig. 5, except the additional mechanism and plan of the circuits at the middle of the line or cable. This additional contrivance is a self-adjusting repeater or relay magnet, consisting of only one small spool of two to four ounces of insulated copper wire, and a perfectly balanced armature or vibrator, arranged and combined in such a manner as not to require an adjusting spring. It regulates itself to the variations in the strength of the magnetism produced in the coil by the electric current, and works as well upside down or on its side as it does in any other position, and it will also work as well while the magnet or helix is in constant motion as when it is stationary. The size of this repeater is such that it may be incased in a box about three inches long, two inches wide, and two inches deep. This relay or repeater is arranged inside of a hard or bone-rubber case, hermetically sealed, the proper connections of the conductors being made, after which this box containing the repeater is itself incased in another vessel or contrivance similar in its exterior appearance to a bombshell, as shown at A and B, in Figs. 7 and 8. This shell is formed in two parts and put together by means of a screw thread. On each side of it are two projections, *y* and *z*, which are designed and arranged for making a perfectly tight joint at the places where the cable or conductor passes through to the interior case and repeating device, and they are arranged something like packing-box joints in steam engines and elsewhere. This outside case is made of copper, or any substance to resist pressure in deep water. The repeater being properly arranged and the moveable pivots set in jewels, the electrical points of contact armed with a metal which does not corrode, the whole is securely placed in the hard rubber or other suitable case and hermetically sealed ; then this case is fixed inside of the bomb-shell-like case, when the cover is fastened down and hermetically sealed by brazing or otherwise. The cable or line conductors project out at each side, as shown in Fig. 7, at *w* and *x*.

The mode of laying the cables and repeating device may be as follows :—At mid-ocean, or other given point, after the proper splices and connections are made between the repeating device and the ends of the cables, and after the connections are properly made and tested, the repeater may be thrown overboard with the cable from the carrying vessels, which may then sail for each shore, paying out the cable or line as they proceed ; or a vessel may start from one shore and proceed to the other, and when at the desired place to have the repeater, proper connections may be made, when the repeater may be thrown overboard, as in the first case, and the vessel proceed to pay out the balance of the cable. The necessary ground connections of the repeating circuits may be made with the outside metallic casing, or copper chains with anchors may be arranged for such connection, and serve also to anchor the repeater down. By this arrangement it will be seen that the patentee hermetically seals and submerges operators in the middle of the ocean, which practically perform the duties of signal officers. The signal being sent from the starting point to them (which may be at a distance equal to the extreme length that an electric impulse or wave can be transmitted through a conductor or cable), these signal men, as it were, automatically send it on again to the next point or station, which may be just as far as the first stretch. This arrangement is called the double-stretch circuit, while the one represented in Fig. 5 is termed the single-stretch circuit. The mode of operation of the electric current through the circuits, and also the office and action of the mechanism of the repeater, differs but little from the plan in Fig. 5. The apparatus and batteries are exactly the same. The only difference being in the repeater and the change of the single circuit into a double one. The first circuit being formed by commencing at battery B (sending station) and passing through wheel C, line or cable D, and coil E of the repeater, and to the ground F, L, back to the battery. The second stretch commences at the battery at the receiving station, and passes through wheel C, and line or cable J, and armature or vibrator H of the repeater or relay, and on through G, K, and A, back to battery B. It will be seen by this arrangement that the line is divided into two parts, and each circuit is broken or disturbed at two distinct places in each section. The more a line or circuit can be broken up the more effectually is the return current destroyed and prevented from forming. It has been shown before, Fig. 5, that two breaks or openings in the circuit were produced in the arrangement for the single stretch. Suppose this line or cable to be one thousand miles long. Now, in Fig. 6 the repeating signal or circuit closing and breaking apparatus is placed in the middle of the entire distance, which, is, say two thousand miles, so that each stretch is just as long as the single stretch in Fig. 5. Under the former system of operating there never need be any difficulty at the sending station with the ground or return current, as the circuit breaker or key can be placed between the line and the battery, and when an opening or break is made at this key point the battery current is entirely and effectively cut off from the line, but under the old system it is not so at the receiving end or station, where there is no break or disturbance produced in the abnormal current and circuits formed at the receiving end by the receiving battery. In this plan it is quite different. The space at *e*, Fig. 6 (receiving station) is kept open alternately, accordingly as a tooth or notch of the

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revolving wheel C comes in contact with the corresponding mechanism which closes and opens space *e* (Fig. 6). In order that no ground circuit should be produced from the continual intermission of the battery current by the continuously revolving wheel C, another opening is formed in the receiving circuit at I, and armature or vibrator H This opening is never closed except when the vibrator H in the repeater is attracted or drawn forward by a current of electricity acting upon magnet or helix E.

The magnetization of the coil E, and consequent attraction of the vibrator H, takes place precisely at the same instant that the tooth or point corresponding to the depressed key closes the spaces *e* and *b*, and the current from the battery produces the effect upon the magnet E, &c, at the same time the vibrator H is drawn forward which closes the space at I, and the wheel C at the receiving station being in unison with the sending revolving wheel, the space at *e* is synchronously closed with I at the repeater, and *e*, *b* at the sending instrument. The resultant action being the indicated signal or letter at the receiving station. In order that the receiving mechanism may be used to send back to the other or sending side, a double conductor and corresponding connections in the repeater are necessary, or a double arrangement of the repeater with a single conductor may be employed.

GRADUATING LUBRICATOR FOR STEAM-ENGINES.—With a view to produce a lubricator with few parts, constructed and arranged in a simple manner, and yet retaining the character of graduating the flow of oil, so that the operator shall be able to control it, and also containing a feed opening, independent of and separate from the valve-stem, Mr. John Broughton, of Center-street, New York, has invented an improved arrangement.

CUPOLAS AND BLAST-FURNACES.—The invention provisionally specified by Messrs. Grierson and Rigby, of Manchester, consists in a method of working cupolas and blast-furnaces without the aid of a fan, or such other apparatus. For this purpose they close the upper end of the cupola or blast-furnace, either by a movable or permanent cover, and apply a flue thereto, leading to a steam engine, or other chimney. Where several furnaces are employed separate flues from each may pass to one chimney; or, by another plan, instead of discontinuing the top of the cupola or blast furnace at the height required for the charge, they erect a chimney thereon of suitable dimensions for the necessary draught.

BRICKS.—The quantity of bricks making for the Portsmouth harbour works is something enormous. At the Chatham Dockyard Extension Works there are three brick making machines, each of double delivery. One is Messrs. H. Clayton and Co's, and the others have been working with Mr. Clayton's delivering rolls, or "revolving dies." About 1,000,00 bricks per month have been made by these machines during the past season. The nine kilns at work will contain each about 120 000 bricks, and about 40,000 bricks have been used in the construction of each kiln. The kilns go a month, in all, between charging.

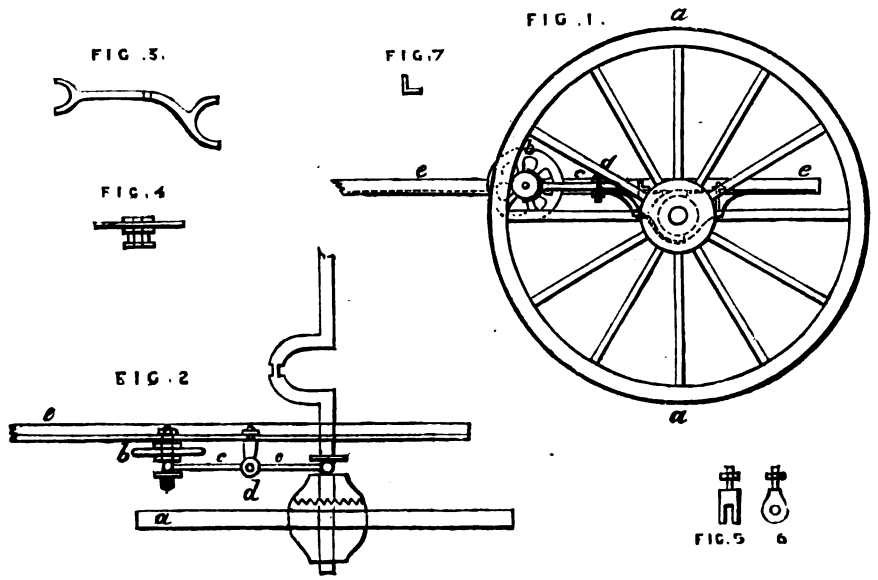
STEAM-BOILER.—The invention of Mr. James Connery, of Wilmington, U.S., relates to a steam generator, the fire-box of which is completely surrounded by a water-jacket. Suspended from the crown sheet of the fire-box is a cylinder, which communicates with the water space of the boiler. The outside diameter of this cylinder is much smaller than the inside diameter of the fire-box, and the annular space thus formed in the fire-box is occupied by a series of pipes emanating from the lower part of said cylinder, and terminating in its upper part, in such a manner that a very large heating surface is obtained, and the water is caused to circulate freely throughout the boiler. From the crown sheet of the fire-box rise a series of tubes through the upper part of the water space and through the steam space of the boiler; and by these means the heating surface of the boiler is still further increased, and the steam in the boiler is dried and partially superheated.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

THE VELOCIPEDE.

Sir,—I think it the duty of every subscriber to your valuable paper to endeavour to benefit his fellow workmen, and as you have been so very kind and liberal in your offer to assist us I venture to address you on the subject of the velocipede, as many of your readers seem interested in it. Begging your correspondent G. W. Walton's pardon, I must say he has overlooked one important point, namely, going down hill. If he were to attempt it with a velocipede made on his present plan he would soon arrive at the bottom, for his ratchets would give way if he held back his lever, then the wheels would slip and away it would go. Now what Mr. Walton proposes to do with two pair of ratchets without being secure, I propose doing with one pair and that most safely.



If I were to make a velocipede I should secure one wheel fast to the driving shaft, and keep the other loose to be fastened with a pair of face ratchets, one side cast on the nave of the wheel, the other to work loose on the shaft, to slide on two keys bedded in the shaft to be thrown in gear with the hand wheel *f* and fork lever *c c*, when wanted for up or down hill work or thrown out of gear when turning a corner, the hand wheel *f* to work on a screw fastened to the side of the velocipede; *a*, *a*, is the driving wheel. *f* is the hand wheel to work the fork lever *c* for throwing the ratchet out or in gear; *e* is the side of the velocipede, made of 1½in. angle iron, shown in Fig. 7. Fig. 1 is a side view, and Fig 2 a top view, showing it in working order. Fig. 3 shows the fork, Fig. 4 the hand wheel, with groove for one end of fork; Figs. 5 and 6 the knuckle joint The fork lever works in a knuckle joint at *d*, in Figs. 1 and 2. J. ROBINSON.

PHOTOGRAPHIC PICTURES IN NATURAL COLOURS.

Sir,—I was much struck with your first number of the *Mirror*, and the remarks subsequently made in the ENGLISH MECHANIC on the subject of photographic pictures in natural colours; these led me to take in your journal, as photography in natural colours is a subject I have been working at since 1852. At that time, when in a remote part of Burmah, I commenced a set of experiments with chemicals procured from Sutton and Diamond's in Holborn for the purpose I was not at that time aware of what had been done by others. I was, however, for the most part unsuccessful until, about three years ago when, after experimenting in the same way at Masulipatam. I was requested by my wife to "give up *messing* and do a good photograph of the house to send home." I commenced at about half an hour before sunset and was surprised to find the blue, yellow, and red of the sky rendered in the negative, and also the same colours repeated inversely in the reflection of the sky in a tank in the foreground. The picture was a stereoscopic one. I tried another immediately afterwards in precisely the same manner, but scarcely a trace of colour was to be seen. The colours, such as they were, remained, and about two months afterwards, a friend, on looking at the pictures, remarked that the green of a particular tree was just like that of the original, to which he pointed. I could however, only discover a very faint green in a particular light. This was the last of a particular collodion I had myself made, and the bath soon after got disturbed, and was dried up during my absence on a march. The photograph in question was left in some baggage, which had not arrived at Madras when I quitted on sick leave. When I return to Madras I intend pursuing the subject as far as my professional engagements will permit; but in the meantime I think it highly probable that the art will be discovered by some of the learned in this country. E. D. EVEZARD, Surg, Madras Army.

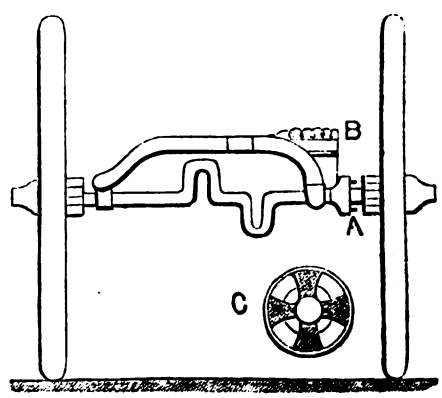
IRON GIRDERS AND BEAMS.

Sir,—After reading the letter on iron girders by Thomas Cargill, C.E., in your last number of the ENGLISH MECHANIC, I am induced to offer a few remarks for the information of your readers respecting iron girders, beams, or Carlings. They can be rolled either with double tee flanges or with single tee and bul flanges in one piece up to 11 inches deep the former are suitable for bridges and the lower decks of large ships; the latter for upper deck beams of any size vessel Beams or carlings of any depth can be made by rolling them in two pieces and welding them along the web or middle longitudinally as practised by the Butterley Company, and are made to any required form without riveting. Consequently, the beam or girder is in one piece when finished. If the frames of the iron ships of the Royal Navy and large merchant vessels were manufactured in this manner, greater strength could be obtained with a great saving in weight, the frame being in one piece instead of a compound of plate, angle iron, and rivets. JOHN ELLIOTT.

VELOCIPEDE MOTION.

Sir,—I have before me a drawing of the driving wheels of a velocipede, which appeared in your journal at page 160. Now, there is no need of 2 clutches. While one wheel is free, you can turn any corner be it right or left; the teeth also, are cut in a slanting direction, and would only hold one way, being of no use while the machine is being backed.

Annexed is a drawing of the hind wheels of a steam machine I have nearly finished.



A, clutch (withdrawn from face of nave to show the working), which slides on axle.

B, spring which holds clutch in position till withdrawn, which is done by means of a chain from driving seat.

C, face plate of nave for the pins of clutch, A, sliding into. A. W. FORBES (Edinburgh).

ERRATA.—In No. 42 of the ENGLISH MECHANIC, page 197, last line but one of my article on cutting screws by change wheels, there occur five marks of equality =. Of these, retain the first, omit the second, and convert the third into full stop.; same line for 22½ read 42½; next line omit the =.

HERBERT HURST,
Enfield, N.

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OUR SUBSCRIBERS' NOTES AND QUERIES.

CENTRIFUGAL MACHINE.—Will any reader inform me how many revolutions a centrifugal sugar drying machine makes per minute, or of any work which contains a description of such machines with its price, and where it is to be had? MAGIS ET MAGIS.

VARNISH.—Can any photo correspondent tell me how to manage a varnish that destroys the film whilst drying before the fire? I am aware that a weak solution of gum as a preliminary to the varnish will do, but that is too much trouble to one whose time is very much taken up.—D. W.

PRESERVING INSTRUMENTS.—Can any reader inform me how to preserve mathematical instruments without using oil or grease? A. C.

WATER PRESSURE.—Can any reader tell me how much more water should I get from a 1in. pipe in the hour by increasing the pressure 2 3 and 4 times (say to start with, I get 100 gallons per hour)? T. GREEN.

HEALEY'S CHUCK.—Will H. H. inform me in what work on turning I can find a description of Healey's chuck mentioned by him in No 42 of your journal? T M.

COG WHEELS.—Will any reader inform me how to find the pitch lines of cog wheels?—WM. GALE.

LEATHER STRAPS.—Can any reader inform me how I can join driving straps with cement without laces?—W. FARN.

CANADA BALSAM.—Can any reader inform me of any means other than that of heat by which I can render Canada Balsam which has set hard in a bottle, soft and fit for use, permanently preferred?—MICROS.

DARK TENT.—Can any reader give me instructions for making a Dark Tent as used by photographers in the field?—CRYSTAL PALACE

ASTRONOMICAL INSTRUMENT.—Can any of your correspondents inform me how to make an instrument to compare the spectra of the sun, metals, &c., or describe the method employed?—E. T. HARTLEY

STAINING LEATHER.—Can any reader inform me how to stain leather a buff colour and also how to grain leather that is curried a dark colour in the grain? J R. S.

CHOKE DAMP.—Can any reader inform me how it is that if the air be withdrawn from a coal mine, it is found on reoccupation to be filled with choke damp. I am quite aware of the formation of choke-damp *after* an explosion but it is where no such accident has occurred that I have difficulty in accounting for the production of that noxious fluid. F C S

BUNSEN'S BATTERY.—In vol. 1. No. 18 of the ENGLISH MECHANIC a description is given for making the carbon for a Galvanic Battery; but to be mounted the same as what mine is therefore, they have to be "Platinised." Could any subscriber give full particulars how the Charcoal Cylinders are made, and what they are made of for Bunsen's Battery, and also the size for a quart battery?—D BARHAM.

LIQUID INK.—Can any reader give me information on the following subjects:—1. I want a solvent for Indian Ink but one that will not hurt the pen), or a recipe for making liquid ink? 2 How to colour tracings on cloth?—A DRAUGHTSMAN

HYDRAULIC ENGINE.—Can any correspondent explain how a steam engine is worked by hydraulic pressure, instead of steam? I understand there is an engine on this principle in the lead mines at Silverdale, Cumberland.—ARCHIMEDES.

HYDROGEN GAS.—I am often using the above gas about 6 cubic feet at a time. I have tried several times to make it with diluted sulphuric acid and zinc, five of water to one of acid in a Wolf's bottle that will contain about 3 pints On each trial it has proved a very slow process. I only get about 2 cubic feet in one hour Will any reader inform me of the easiest and most expeditious method of making the above gas in quantity similar to my requirements? There is a method by passing a jet of steam through an enclosed charcoal fire the oxygen being absorbed by the charcoal, while the hydrogen passes through I have not tried this.—J P. LEWIS.

DARK PORTRAITS.—I lately purchased a second-hand camera and lens with chemical apparatus, &c., thinking to obtain good portraits from it, but all that I have taken have proved so very dark that I get laughed at for my pains. The room I take the portraits in is about 13ft square, with one window in it. I use white curtains for a background. Will any kind correspondent assist?—AN UNSUCCESSFUL AMATEUR

NEGATIVE COLLODION.—Many thanks to R. H. P. Will any reader of the MECHANIC answer me the following questions? 1. How to make a good keeping negative collodion, suitable for instantaneous portraiture? 2 How can the stain be removed from stained glass so that it may appear transparent? I want to write letters on it or ornament it.—A. P.

MAGNESIUM WIRE.—Can any of your readers give me any information as to the practicability of burning magnesium wire, either alone or in combination with cotton as the wick of a small candle or taper? J. E. H.

REPLIES TO QUERIES.

MICROMETER.—I am not resident in London, and cannot, off-hand, supply T W. B. with the drawing of Mr. Lassell's mounting which he requests; but if he will wait until I visit town, I will try and get him what he wants in the shape of a sketch or sketches of Mr. Lassell's (and also of Mr de la Rue's) equatorial mounting for a reflector I may mention incidentally that Mr. Slack, the editor of the *Intellectual Observer* exhibited what seemed to me a very effective mounting at the soiree given by the President of the Royal Astronomical Society at Willis's Rooms on Wednesday night Mr. Slack is a personal stranger to me, but I have no doubt that an application to him by T. W. B would meet with that courteous attention which is always accorded to such applications by eminent scientific men.

With reference to the spider line position micrometer (which, of the two, I consider the better instrument for an amateur) I will describe my own, now lying before me, as being of dimensions suitable for such a telescope as your correspondent possesses. It consists then, of a circular brass plate, 4 inches in diameter and 0·1 inch thick, toothed on its periphery and divided into 36°. This is read to 1' by means of a vernier attached to the part next to be mentioned. Upon the perforated axis of this circle turns a rectangular brass box 3·5 inches long, 1·6 inches wide, and 0·6 inch deep. This box contains two forks which slide one within the other in opposite directions. Across them are stretched the spider lines with which measurements of distance are effected. To each of these forks is attached a screw 0·2 inch diameter cut with 100 threads to the inch: these screws project through the ends of the brass box, and enter two milled heads with each of which is connected a circle, 1·95 inch in diameter, graduated into 100 parts, and read from a line cut upon a small brass arm, one of which projects from each end of the box. Of course the motion of either of these heads through one division of the circle moves the screw and its attached fork 0·01 inch The forks are pressed in directions opposite to those in which they are drawn by the screws, by two weak springs There is also a blackened metal plate contained in the box with a comb on one side of it; which comb is cut by the same screw tool as the micrometer screw. The zero division of this in the centre terminates in a circular hole, and every fifth and tenth division is made longer for facility of counting. The object of this comb is to read off whole revolutions of the micrometer screws. Parallel to the edge of this comb, and most accurately at right angles to the direction of the two moveable wires, is stretched a fixed one for the measurement of position. It will be obvious that these three wires must be as nearly as possible in the same plane, as they have to be viewed simultaneously with a powerful magnifier This magnifier is an ordinary positive or "Ramsden" eyepiece, sliding into a tube at the top of the box and of these eyepieces three at least will be required Finally, the whole box, micrometers, screws, eye-piece and all, moves round the axis of the position circle by means of a milled head and pinion working at one end of an arm immoveably fixed to the bottom of the box The other end of this arm carries the verniers as mentioned above, for reading the position circle. My own micrometer is one of the late Andrew Ross's. Troughton and Simms' differs from it only in the fact that the part carrying the vernier in their instruments is a plate and not an arm. I may just mention one subsidiary contrivance and that is of the top plate of the micrometer box, which moves by a rack and pinion, so as to bring the eye piece centrally over each wire and so avoid parallax. I should, perhaps, also say that the entire micrometer (position circle and all) moves with very stiff friction in the tube by which it is screwed to the eye end of the telescope. This as in the double image micrometer, is for the adjustment of the zero of position The double image micrometer consists, in effect of an ordinary terrestrial eye-piece, the third lens from the eye end being bisected The semi-lens moves accurately in the direction of the diameter of the lens and consequently at right angles to its axis As to the relative practical value of it, and that of the wire micrometer, I apprehend that there is but little to choose between them I think though, as I commenced by saying that the amateur can employ the wire micrometer more easily than the double image one; at least, the latter possesses the unquestionable advantage in the case of faint objects of requiring no artificial illumination

One word of caution to T W. B. in conclusion. *Let him on no account attempt to make a micrometer himself* Very very few opticians can turn out even a moderately decent one. The extraordinary difficulty attending the cutting of a perfect screw is, *in limine* an almost insuperable obstacle to the mass of tradesmen. What then can an amateur possibly hope to do? I think that if T W B. could dissect a high class micrometer, he would scarcely need my advice in this respect. Let him, if he wants to save his time and money, go to Troughton and Simms, Dollmeyer, or Dollond (I should add Cooke's name but for the fact that his exquisite micrometers are made part and parcel of his telescope tubes themselves) I feel morally certain that the comparison of one of their instruments with a *chef d'œuvre* of his own would induce him to thank me sincerely for this hint *Verbum sat sapienti.*—A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

ELECTRIC.—In answer to A N I beg to say that I have a cylinder machine (home made) which acts somewhat similar to his. I find mine performs better by throwing the silk back off the cylinder. I attribute the loss of electricity to its flying off from the fine filaments round the silk, and from the dust which collects on the outside In machines made for sale the silk appears to be varnished I cannot say whether that prevents it ARRW.

ELECTRICAL MACHINE.—In reply to A N, in No. 43 I beg to say that I have an electrical machine very similar in construction to the one he describes, but smaller, being only 10½ inches in length and 7 inches diameter. The only important differences are, first, that the cushion in mine is not insulated, but, on the contrary when in action is connected by a chain with the ground. The one described by A. N appears to be perfectly insulated. Secondly, that the whole of the ends of the cylinder, as well as the caps are covered with sealing wax varnish and this is, I believe really necessary. The hole in the cap of which A N. speaks would make no difference whatever, especially when the ends are covered with sealing wax Mine has power sufficient for all ordinary purposes, although it is a very old one, and has many defects apparently much more serious than A. N. has to complain of It has a wooden axle through the centre, a hole 1·6th of an inch in one of the caps, and is by no means true to its centre. I shall be glad to learn if A N. succeeds, and shall be happy to give him any further information.—J. E. H.

ELECTRICAL MACHINE.—I beg to offer one or two remarks in answer to A. N, who states that his Electrical Machine will not act. I made one of about the same size and of the same kind a short time since, which acted remarkably well The first thing I notice in A. N.'s description of his machine, is that as the cushion is insulated, a metallic chain or wire having communication with the table or earth should be attached to the back of the cushion. In my machine the cushion was not insulated. If A. N has not provided a chain for his cushion that may be the cause of failure. 2ndly. If the silk flap from the cushion approaches too near the points of the conductor the machine will not act 11in is quite near enough. These are the only two circumstances I notice likely to interfere with the action of the machine, supposing it perfect in other respects A N. states that his conductor is made of tin (japanned). I suppose he does not mean that it is covered with a non-conducting material. The best conductors are those made of brass, and the next best those made of wood covered with tin-foil.—R. T.

POWER OF MICROSCOPE.—A correspondent asks for an explanation regarding the powers of his microscope Perhaps it may help him out of his difficulty to learn that the power ascribed to microscopes in advertisements is usually given according to the superficial area; thus a power of 6,000 corresponds to about 77 diameters, so that his piece of moth's wing should appear 7½ inches long and of the same breadth. But your correspondent must also remember that all persons unaccustomed to microscopes at first fancy the objects to be less magnified than they really are.—E F. H.

BOILER PRESSURE.—Many thanks to Mr. Tonkes for the formula he has given But he must be aware that it will take a less pressure to break or burst a boiler that has been in use for a length of time than it would when new. For instance, if his formula will show correctly the bursting pressure of a new boiler, does it also show the bursting pressure of an old boiler? For it is evident that a boiler will be the worse for wear and therefore will bear less pressure than when new. DAVID KNIGHT

THE STEAM DOME.—W Berry wishes for information tending to the advantages of the steam dome. In all well designed boilers a steam dome or chamber is a positive essential. Every boiler is supplied with a certain amount of steam room, or what, when in use, is considered by some engineers equivalent. For instance many engineers work their boilers when the steam room is not properly proportioned at a higher pressure, but this plan has many objections, causing the boiler to prime, and increasing the liability of explosion In lengthening the boiler or increasing the diameter the objections are obvious though these are means often practised. Applying a separate steam chamber obviates all these difficulties; by this plan you obtain the required steam room with a boiler of small diameter, decreasing the danger of explosion, your steam is drier the spray and water caused by priming of the boiler is decreased in its activities of entering the cylinder by the greater distance it must rise from the surface and the smaller space in which it has to act To explain the advantages and defects of the different plans of increasing the steam room without decreasing the strength of the boiler, would take more time than I can at present spare; but I hope that the rough sketch of the advantages and defects for and against the usefulness of the steam dome, will influence Mr. Berry towards having one for danger, economy, satisfactory work, and therefore expense all stand in its favour.—A. N.

VENTILATION.—I beg to inform Ventilator, No. 43, that I have found the "Aimot Ventilators" answer very well, provided a sufficient number be distributed at bottom and top of external walls; one air brick could not be expected to give sufficient ventilation.—J. I.

COMBUSTION.—(James Robertson, Jan. 19.) The Argand and all other light-giving gas-burners cause a deposit of soot on whatever is heated over them Apparently the inquirer is unacquainted with the "Bunsen" Burner (so named after its inventor, M. Bunsen, Engineer, of Berlin) which gives intense heat without the slightest deposition of soot, and which at the same time serves as a stand or support for any vessel to be heated over it Any gas-fittings manufacturer will supply it and explain the mode of tempering the exact proportions of gas and atmospheric air as is requisite in using this most useful implement. The price is from 4s. 6d to 7s. 6d. exclusive of a short piece of India-rubber tube to connect it with the gas-bracket of the room.—C H.

COMBUSTION.—Instead of the Argand Burner let James Robertson use a number, more or less according to the size of his flask, of small gas jets, and place his flask over but not quite touching them; he will then obtain great heat, and will not be annoyed with smoke or soot gathering on his flask If it be a small flask 3 jets will do very well.—MAGIS ET MAGIS.

LATHE MOTION.—If F. G. B. would give a better explanation of what he wants, I might be able to assist him. If he desires to obtain a slower motion with increase of power there are several easy modes of obtaining it; all, however are a combination of pulleys Should he use a set of pulleys overhead, I should advise him to give them a lateral movement, so that, if necessary he can bring any pulley he desires over any corresponding pulley on the other by such a combination of pulleys he will be able to obtain a great variety of speeds and powers I see no particular objection to his making his lathe self acting in the way he proposes. I know of a lathe so arranged, and it acts satisfactorily. If he sprinkles his straps with powdered resin, the straps will hold firmer.—ADRIAN NEISON

SPEED OF LATHE.—In answer to F. G B. I must remind him that by whatever means he lowers the speed of his lathe, he does not increase the power on the cone-pulley. The proper way to give his lathe more power would be to make it double geared. The way I improved my own single geared lathe was by making a face plate to screw on nose of mandril (as large in diameter as possible) with sheave

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groove on edge, and fitted with centre &c., to drive like a railway wheel lathe. It turned off shavings very nicely I also fitted one as a drill chuck with which I used a 1/" drill. I must add that my lathe is a 6" centre.—ARROW.

LATHE AND FRET SAW.—F. G. B had better get a double geared head to his lathe if he wants to take a stiff cut He can hear further about it by writing to me. John He bert inquires about fret saws By writing to me he can have any information I can also give him some hints on the moulding machine he enquires about.—E. L., 5, Plaisance cottages Jersey.

BLUE PICTURES BY THE CYANOTYPE PROCESS.—In answer to Iodine, very pretty blue pictures may be produced by this process as follows:—

Ammonia-citrate of iron	... ...	40 grains.
Distilled water	... ...	1 ounce.

Spread evenly over the paper, by means of a flat brush or a glass rod, the above solution. Allow to dry. Expose to light under the negative for a few minutes in the sun, or from half an hour to one hour in the shade, depending on the intensity of the light. Spread over the paper in the same manner as above the following:—

Ferro-cyanide of Potassium	... ...	1 drachm.
Water	... ...	1 ounce.

Which immediately on being applied becomes of a blue colour. Allow to remain a few minutes, then wash in water, and a blue positive picture will be the result To prevent the picture fading, apply a solution of carbonate of ammonia which turns the picture of a lavender colour; then wash in water and dry, when the blue colour will be restored. If the picture has not been exposed long enough, it will be very faint.—A. P.

A CURIOUS ACOUSTIC FACT.—Under this heading appears in No 23, vol 1, of the ENGLISH MECHANIC an article respecting the absence of sound in the centre of a bell whil at the same moment it was sounding loudly outside. As Acoustics have a bearing of no little importance on matters of every day life. I have thought an explanation of my my theory might be useful. Presuming that the theory of vibrations is generally understood I may commence by observing that the aerial waves or pulses propagated by the external surface of the vibrating bell flow freely outwards in all directions and being unrestarded in their course may reach the utmost parts of the chamber or beyond But inside the bell it is quite a different matter the aerial waves flowing from the inner surface of the bell have no exit there, but are met and checked equally at all points by pulses in exactly opposite directions, thus completely counteracting each other before they reach the centre, where in consequence there can be no sound An occular proof will be a wooden hoop thrown into the water you may agitate sufficiently to cause ripples to extend several yards outside the hoop while they will only extend from he inner surface a few inches towards the centre where the water will remain comparatively smooth. This affords a hint for the construction of a quiet chamber, &c —YOUNG IDEA.

PAINTING MAGIC LANTERNS.—For painting magic lantern slides I always draw the outline with India ink, and filling in with any of the following colours or mixtures of them: Carmine, lake, burnt siena, spia indigo, gamboge, and Prussian blue The colours must be used as thin as possible, and varnished with Canada balsam to render them transparent.—E. T. H.

TRANSFER VARNISH.—The following may suit John Taylor:—

1. Genuine pale Canada balsam and rectified oil of turpentine equal parts.

2. Mastic in tears and sandarach each 4 ounces; rectified spirit 1½ pint; dissolve, and add pure pale Canada balsam half pint

Both excellent for his purpose for Diaphanie, engravings, lithographs &c T. K.

MODEL ENGINE CYLINDER.—Thomas Crowe can obtain a brass cylinder of the size he requires at the Phœnix Works Wolverhampton, price twenty shillings.—G J.

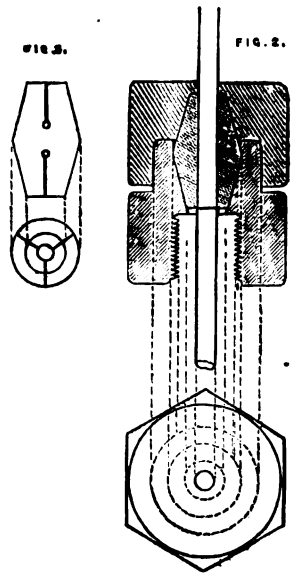
MAGNETIC INSULATION.—I thank Mr. Alexander for putting me on the right tack in reference to his Patent Compass. I consider it quite original and very clever and I wish him every success. But I still retain my opinion on the possibility of insulating a magnet and hope soon to communicate some of the experiments on which it is founded.—R. W. WILLIS.

TO CLEAN OLD BRASS WORK FOR LACQUERING.—Mr S. Stevens might try the following and state how it suits. First boil a strong lye of wood ashes, which you may strengthen by soap lyes; put in your brass work, and the lacquer will immediately come off; then have ready a pic le of aqua fortis and water strong enough to take off the dirt, wash it immediately after in clean water, dry it well and lacquer it.—DAVID KNIGHT

DISSOLVING GOLD AND SILVER.—Young Mechanic will find that nitro muriatic acid (a mixture of nitric and muriatic acid) will readily dissolve gold and nitric acid silver. I believe that alcohol poured on the surface of the solution of gold will take up the gold from the acid, and by being applied to the steel will gild it.—E F H

CEMENTS.—Armenian —Dissolve 5 or 6 bits of gum mastic, each about the size of a large pea in as much rectified spirit as will suffice to render it liquid, and in another vessel dissolve as much isinglass previously softened in water (the water not to be used), in French brandy or rum, as will make a 2 ounce phial of very strong glue, adding two small bits of gum gambaum or ammoniacum, which must be rubbed or ground till they are dissolved; then mix the whole with sufficient water. Keep the glue in a closely stopped phial; when intended for use, set the phial in boiling water Chinese.—Fines pale orange shellac broken small 4 ounces; rectified spirit (the strongest 58, o p.) 3 ounces, digest together in a corked bottle in a warm place until dissolved; it should have the consistence of treacle. Both the above are very strong, and the very best for wood, glass, ivory, jewellery, and all fancy works.—T. K.

CHUCKING.—I forward a sketch of a double cone chuck for holding rod metal, which may answer this correspondent's purpose; fig 1 is a plan of the chuck shewing the hexagonal nipping nut; fig. 2 is a sectional elevation through the centre shewing the arrangements of the parts: fig. 3 is a plan and elevation of the double cone. The spindle of the lathe is bored up and the rod is inserted leaving as much projecting in front of the nut as will make say two nails, then tighten the nut, which will make the cone advance, and nip the rod tight when the first



two are finished and cut off, slack the nut and draw out the rod as before and so on till the rod is exhausted. The cone is made of steel with three slots in each end, ending in a small hole as shewn in the sketch (No 3) this allows the cone to spring a little and so retain the rod quite fast when the nut is screwed up tight. This chuck is both convenient and true in its operation, and by having several cones of different diameters internally may be made to take a variety of sizes.—J. D.

STEAM DOME.—In answer to W. Berry (No. 43,) respecting a steam dome on his boiler:—When steam is generated with great rapidity, and in small spaces, it mixes with the water, so as to produce a foaming, which is often very troublesome and even dangerous; also sometimes water passes off along with the steam. To obviate the latter, which is termed *priming* the steam is allowed to ascend to an upright chamber called a dome, where, being in a state of comparative rest, it deposits the water and after being freed from it passes into the steam-pipe and thence to the engine. —DAVID SLOAN THOMSON

GOLD LACQUER FOR BRASS —Take of rectified spirits of wine two quarts, and of seed lac three pounds. Pick the seed lac particularly clean and clear off all black and brown specks and pieces as upon that depends the entire beauty of the lac; add them together keep them warm, and shake often; when the lac is dissolved it is fit for use. —DAVID KNIGHT.

MILL FOR GRINDING PRINTING INK.—In answer to Jno. Langley—the paint or colour mills are used by most Printing Ink Manufacturers They are easily cleaned and are made by Joseph Rhodes, Grove Iron Works, Wakefield. S L.

EXCHANGE.—As I have a quantity of Fossil Teeth out of the Black Shale which overlies the low main seam of Coal, I will exchange them to anyone for any rare object for the Microscope. DAVID KNIGHT.—Telford's-buildings, Dudley Colliery, Northumberland.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

P. H S (Richmond road).—Your scheme is a very ingenious one—have you tried it on a model? (We suppose you have done so). Its being an "improvement" is quite another question, and a difficult one to answer in the face of the numerous existing methods. It is better, perhaps, than some, and is patentable. The arrangement of parts is very good, and the control good. We would advise you to try it on your model, carefully noting your results If you don't think of patenting, we will publish it for you.

N. SOULE.—It was done years ago in the Adelaide Gallery. A negro head was fastened to the body by means of two magnets, and the lecturer used to try to cut the head from the shoulders by means of a knife, in which, of course, he did not succeed—though the knife passed through.

A RECTOR writes to us that his church is in a woful condition just now, all attempts to warm it being unavailing, it being "perishing cold round by the walls whilst in the body of the church, the heat is inconstant, but generally far too great." There seem to be eleven large windows to the building These rapidly cool the air. The cure temporary, is this:—To each window level with the inner wall fit a frame, over which has been stretched stout calico Test the temperature, and you will find thereafter that it will be equal, nearly all over the building The reason for the evil is that the glass of the many windows has a tendency to carry away that heat from the air which has not been abstracted by the large surface of cold wall. The draughts also will be stopped by the same means.

A. GILMOND.—Your invention seems original and worthy of adoption. You are not rich enough to patent it; then do as many a good man has done before you, make a present of it to the world. If you do not like this idea in this light, you will doubtless profit by handing it over to your employer.

N. OAR Messrs Shand and Mason of Upper Ground-street. Blackfriars road, will give you all the necessary information you desire.

J. MEASURES.—Apply to Mr. White Bedford-street, Covent-garden, who is the principal agent; the description you require will cost about £4 4s. but the apparatus can be had separate at a very moderate figure, and printed instructions given for fixing it up.

N. SAMWIL.—A taking title, but we don't think it will suit you

G. SMYTHE.—The author is Charles Knight. Try at his establishment in Fleet-street, by *Punch* office.

A PARADOX.—Bourne's is a first-class work; it is appearing in parts, and in this respect will suit you well.

OLD PHILOSOPHER.—You can get the numbers of the MIRROR from the publishers of this journal.

W. MEERS —Your figuring is quite correct, your basis wrong, so it all falls through Were you correct we might anticipate dreadful disasters through the use of the apparatus We have no the disasters, the thing works well; so very fortunately, you are wrong. Don't waste your time.

THOMAS JAMES TURNER.—Received.

F. JONES.—The catalogues of Spon, Weale, Virtue, and Atchley, the booksellers, may assist you but we do not think there is any work published treating sufficiently on the subjects you name to make it worth purchasing.

J. F. ATCHELEY —Stupid, we grant, but will draw attention and good will come of it

R. O. H.—If vulcanised, you can obtain it at any of the large India-rubber manufactories.

ROBERT WATSON.—You can obtain such a work of Weale, Bookseller, High Holborn Respecting the castings, you had better seek the information through an advertisement

T. DANIELS.—There are many agents who live by preying upon young men in search of such employment. Have nothing to do with these, but advertise in the *Railway Journals*

STEAM PLOUGH.—An American invention—not patented in England

SIAM SIAMESE TWINS.—Thanks but already answered

J. P B.—Better try and sell the idea to some honourable firm Do not risk a patent.

MAG. E. V.—Illustrations have appeared in back numbers. Your other questions would require more space to answer than we can well spare.

Q Z K.—We try our utmost to supply the wants of our subscribers, but we must really decline incurring the expense of engraving a tinker's wheelbarrow. It should be, we are inclined to think us less to the majority of our readers. Why not examine one yourself? There are plenty, to be found in the streets of the suburbs.

L. W. N —Sketches received

LEATHER LEGS can obtain the article through any of the large dealers in shoemaker's materials.

HENRY THONG.—Thanks for your offer.

C. J. (Pitchfield-street) —Can you forward us the plan?—it will be returned to you.

A. P. You do not state whether the watch is an English one; but in any case, if the watch makers can do nothing with it, the sooner it is out of your possession the better

J P. WARD.—Drawing received.

WM. FARN.—From what are the blue and starch manufactured? Explain yourself more clearly.

AN OLD HAND.—The committee of the exhibition will guarantee you so far as they are concerned; but such guarantee amounts to nothing. You are powerless after the exhibition is closed, and even while it is open the Americans can be pirating your invention. Thanks for drawing our attention to the article The writer is an amateur only, and perfectly open to correction. The author has not noticed he queries, he resides, at a considerable distance from London. We shall be glad to hear from you at any time.

WILLIAM WILES —There is some ingenuity in the idea, but we are afraid that it would be difficult to work out. Do not risk a patent.

R. L.—Write again Your last may have been mislaid.

D. WHETTON.—We shall be very glad to receive your contribution.

E. R B.—1. Try Spon publisher, of Bucklersbury. 2. We shall publish one shortly.

BRAZIER.—We cannot assist you.

MATTISON —Thanks, but scarcely worth engraving.

J. ROSENZWEIG.—We should prefer the drawing of the velocimeter.

THOS. DAVEY.—Lockwood, Paternoster row.

J. E. H.—In small quantities at any chemical repository.

A. B. C.—The question has been already answered many times in this journal.

T. SMYTHE. We really cannot say.

J. H. RUMBEY.—Your suggestion is good, but we are afraid that we cannot entertain it.

STEEL.—The plates can be made, but they will be expensive. Any respectable manufacturer would undertake the job.

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G. C O.—Received.

ENGLISH MECHANIC.—Articles have already appeared on the subject.

LEYDEN JAR.—Many other answers have arrived.

A. K.—We should like to see some of the crystals. You have been fortunate in your experiment.

BOTTLED ALE.—Through any mechanical engineer

T. T. K.—See back numbers. Bronzing and soldering have both had attention paid to them.

LINCOLN.—Apply to Weale, Bookseller, High Holborn.

JOSEPH STRANGE.—Our correspondent forgot to keep his promise, or was perhaps, unsuccessful in his experiment See letters on the subject in the present number.

TALPA.—We have seen a machine somewhat similar, but it was never looked upon as anything but a curious toy.

ALFRED RENDELL.—Received.

BUTTERWORTH.—Will appear shortly

E. M. J. SAVAGE.—Of any of the American agency offices. We do not know the price, but not expensive.

WANT HELP.—Purchase a book on the subject from Spon, Publisher, Bucklersbury.

A YOUNG JEWELLER will find a recipe in one of the early numbers.

LOCKSMITH.—Advertise in the mechanical papers.

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand, the same with "Well Wisher," &c.

ERRATA.—PRACTICAL PHOTOGRAPHY, PAGE 228.—Collodion *should be*:—

Plain 3, parts, Iodising solution, 1 part,	to the ounce.

INTENSIFIER.
No. 2.

Pyrogalic Acid	10grs.
Citric Acid	20grs.
Water	3 ounces.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

146. George Mellor, York, improvements in machinery for the manufacture of nails and spikes.
154. Francis Preston, Lancashire Steel Company, Manchester, improvements in machinery and apparatus used in the manufacture of steel and iron.
165. Cornelius Varley, Kentish-town-road, improvements in electric telegraph apparatus, parts of the invention being applicable to other purposes.
172. William Sumner, Manchester, improvements in machinery and apparatus employed in casting metal tubes and other articles.
177. Richard Clark, Pinner, improvements in steam engine boilers and railway rolling stock
184. George Tanner, Lambeth, a new or improved apparatus or device for producing theatrical or stage illusions.
186. George Tomlinson Bousfield, Loughborough Park, Brixton, improvements in machines for graining in imitation of wood and marble.—A communication.
194. William King Hall, Sheerness, improvements in steam boilers.
195. Thomas Hutton, Derby, improvements in submarine telegraph cables, and in submerging and raising submarine telegraph cables
196. William Thomas, Dudley, improvements in machinery for making moulds for casting metals.
198. Charles Wyatt Orford, King's Norton, Worcestershire, a new or improved force-pump and garden engines.
207. David Jones, Commercial-road, improvements in bolts for doors and other purposes.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

PROPERTY RECORD.

SALES AT GARRAWAY'S.

BY MR. ROBERT RAID.

Leasehold residence, being No. 39, Fitzroy-square, term 23 years unexpired, at £29 5s per annum—sold for £635.

Freehold house and shop, being No. 13, Gilbert-street, Clare-market, let at £20 per annum—£450.

Freehold house, with garden and stabling, situate at Holmesdale, Lewisham, let at £16 per annum—£455.

Leasehold house, being No 47, Northumberland-street, Marylebone road, let at £50 per annum, term 26 years unexpired, at £7 7s. per annum—£500.

Leasehold improved ground rent of £10 per annum for 63 years, arising out of a residence, being No. 17, Tichbourne-street, Edgware-road—£160.

Leasehold improved ground rent of £12 12s. per annum for 48 years, arising out of a residence, being No. 14, Manchester-square, King's-cross—£190.

Leasehold improved ground rent of £17 10s per annum, for 54 years arising out of three houses being Nos. 20 to 24, Coburg-street, Drummond-street, Euston-road—£345.

Leasehold house, being No. 9, Charles-street, Blackfriars-road, let at £37 per annum, term 18½ years unexpired, at £4 per annum—£155.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Erection of Smethwick Public Buildings.—Particulars of Mr. Y. Thomason, 40, Bennett's-hill Birmingham.

Erection of New Church, Parsonage and Schools at Bradley, near Bilston. Particulars of Martin Baldwin, Esq., Bilston.

Execution of Masonry and other Works connected with the erection of a deep water quay wall, at Newcastle-upon-Tyne.—Particulars at the Engineer's-office, Town Hall.

The completion of the Pier and Floating Stage at New Brighton, and the construction of a Bridge to unite the same.—Particulars of H. A. Sewer, Public-office, Egremont, near Birkenhead.

Construction of an Engine shed for the Works in connection with the Normanton Station, Yorkshire.—Particulars at the Engineer's office, at the Station.

Construction of New Brick Sewers and underpinning various Sewers for the Vestry of the Parish of St. Marylebone.—Particulars of Mr. Robert Scace, at the Court, Marylebone.

Erection of a large Goods Warehouse, at Forth Banks, Newcastle-upon-Tyne, for the North Eastern Railway Company.—Particulars of Mr. Prosser, Architect, Newcastle.

Construction of a Gasholder Tank, 61 feet 6 inches by 26 feet, for the Directors of the Grantham Gas Company.—Particulars of T. Winter, Esq., Clerk to the Company, Grantham.

Erection of New National shools at Great Dunmow.—Particulars of the Rev. W. L. Scott, at the Vicarage, Dunmow.

TENDERS SENT IN FOR BUILDING WORKS.

For warehouses and shops, Park Lane, Liverpool. Messrs. J A. Picton and Son, architects:—Martin (accepted) £5,148.

Erection of eight model cottages at Slough, Mr. William Sim, architect:—Liddiard, £1,261; Caleé, £1,196; Knight and Son, £998: Atkins, £944; Hards, £930.

For fittings for the Railway Hotel, Notting-hill, Mr. T. Munsey, architect:—Selleck, £461; Moultrie, £377; Mudd, £299.

Erection of residences and offices, St. Cuthbert's, Bedford, Mr. Usher, architect:—Dickens, £349; Corby, £819; Day, £813; Cunvin, £793; Wenir and Foster, £765.

For supplying and erecting cast-iron palisade and gates round Chapel Field, Norwich:—Boulton (accepted) £520.

For alterations to house and shop, Kingsland, for Mr. Hide:—Wiltshire, £330; Bennett, £306; Tolley, junior, £264.

For labourers' cottages at Twickenham, Mr. Moye, architect:—Stonner, £505; Ebrem, £503; Wood, £500; Hannay, £409; Staple, £437; Wilpee, £125; Donken, £375; Wibble, £350; Neale, £350.

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	96	0	0	0	0	0
Sheet	do	101	0	0	0	0	0
Bottoms	do	106	0	0	0	0	0
IRON.							
Pig in Scotland	per ton.	3	7	0	cash.		
Welsh Bars, in London	do	7	15	0	8	0	0
Staffordshire	do	8	15	0	—		
Sheets, single in London	do	10	15	0	—		
Hoops, first quality	do	9	15	0	—		
LEAD.							
Pig, Foreign	per ton	20	12	6	21	0	0
Red or minium	do	22	10	0	—		
Quicksilver	per bottle	7	18	6	8	0	0
STEEL							
Swedish faggot	per ton	16	0	0	—		
,, Kegs	do	15	0	0	—		
TIN.							
English Block	per ton	102	0	0	—		
,, Bars	do	103	0	0	—		

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.		£	s.	£	s.
Teak	11	10	12	10	2nd do	12	10	14	0
Quebec, red pn.	3	5	4	15	St. Petersburg yel.	10	10	12	0
yellow pine	—		—		Finland	8	0	10	0
Memel	0	0	0	0	Memel	0	0	0	0
elm	3	10	5	0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Dantzic oak	3	10	6	0	Deck, Plank, Dantzic, per 40 ft.				
fir	2	5	3	10	5 in.	0	14	1	6
Memel fir	3	0	3	10	Staves, per standard M.				
Riga	3	5	3	10	Quebec, pipe	80	0	85	0
Swedish	2	0	2	10	puncheon	20	0	25	0
Masts, Quebec, rd. pine	6	10	8	10	Baltic crown pipe	170	0	190	0
yellow pine	5	0	6	0					
red pine	0	0	0	0					
Lathwood, Dantzic	5	10	6	10					
St. Peter's	7	0	8	0					
Yellow Pine, per reduced C.									
Canada, 1st qual.	17	0	19	10					

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	£	s.	£	s.		£	s.	£	s.
PUMICE STONE per tun	5	0	8	0	Olive, Gallipoli	56	0	0	0
OILS, &c.					Cocoanut, Cochin	52	0	52	10
Seal, pale pr. tun	50	0	0	0	Palm, fine	44	10	0	0
Sperm body	115	0	117	0	Linseed	37	10	0	0
Cod	53	0	0	0	Rapeseed, Eng. pale	56	0	7	0
Whale, 8th Sea pale	48	0	50	0	Cotton, seed	36	0	42	10

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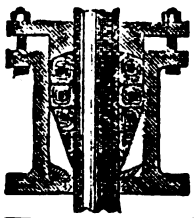

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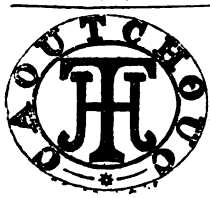

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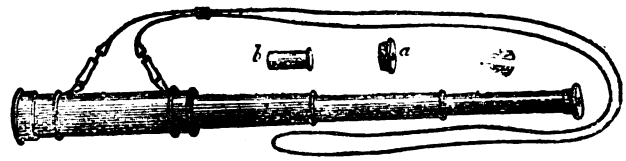

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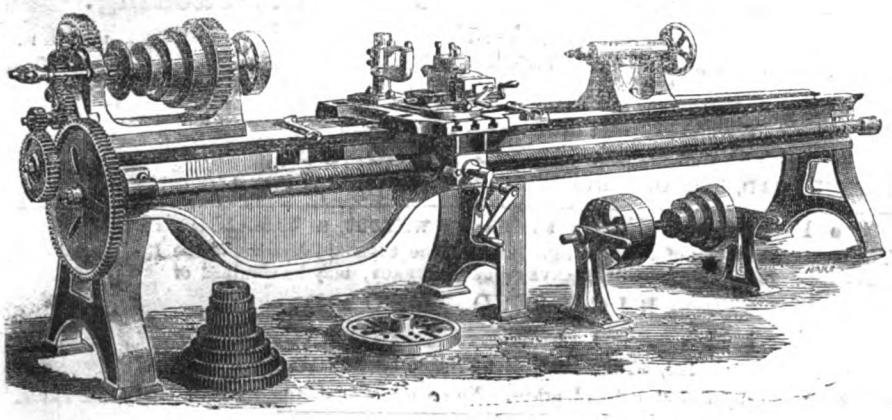

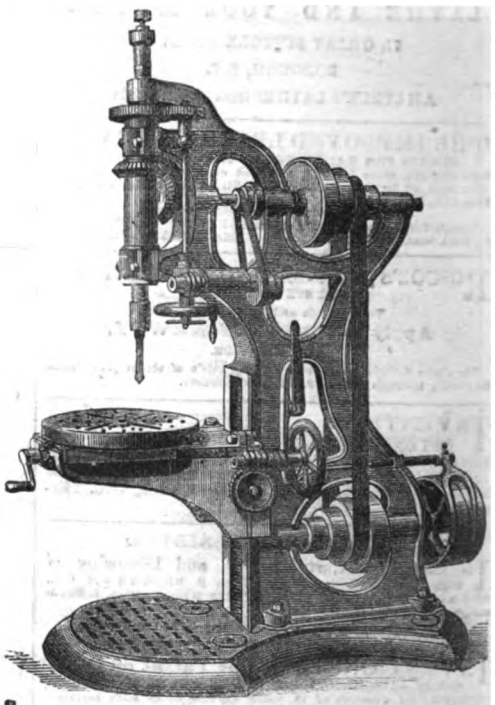

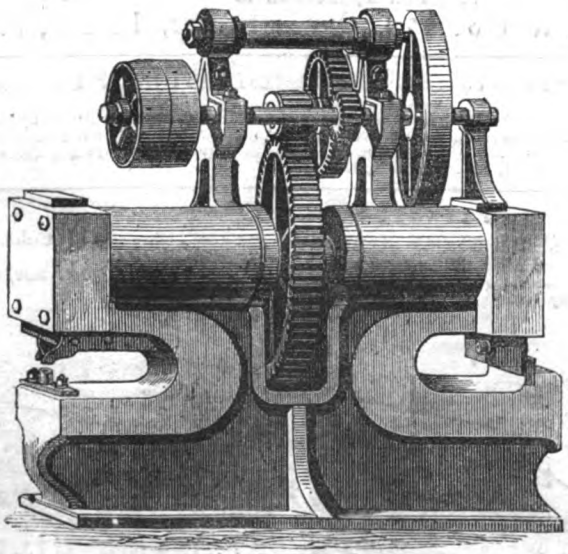

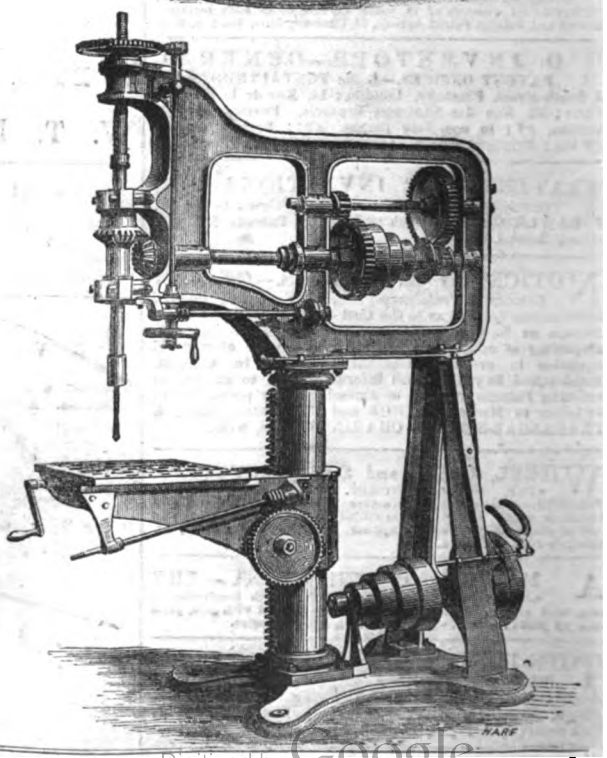

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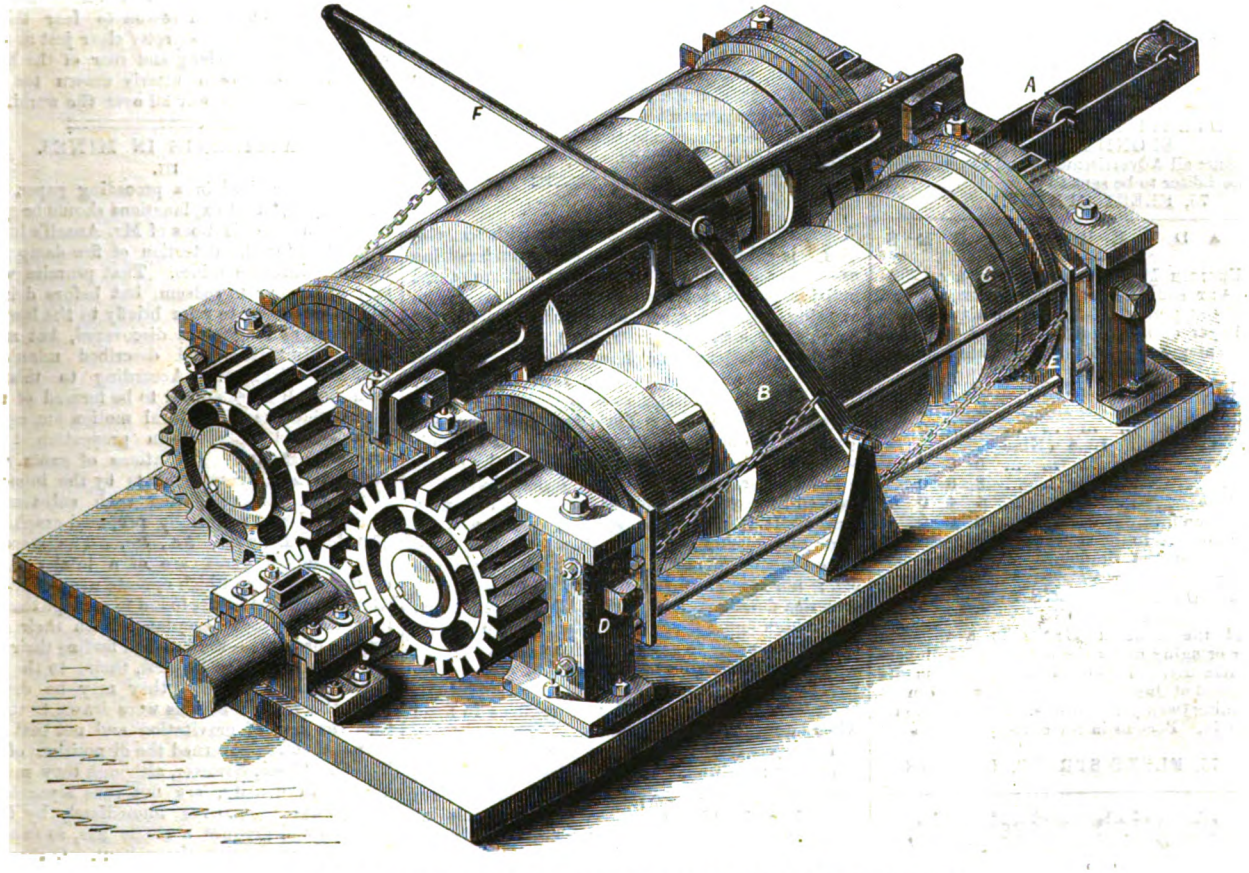
VOL. II.—No. 46.] FRIDAY, FEBRUARY 9, 1866. [PRICE TWOPENCE.



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The patentee, Thos. Cooper, No. 76, West Third-street, Cincinnati, Ohio, United States, has been in the rolling-mill business for the last forty years, and a small-mill roller for twenty-seven years. If the operator desires he can throw the two ends out and form the middle of the axle first, and draw them together again and form the ends, or form and make all at once.

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No. 45, February 2:—Shifting Wrenches, with a page illustration.—Hoffman and Licht's Brick-kiln.—All on the Twist.—Practical Photography, illustrated.—Sewing Machinery.—Bisulphide of Carbon Prism, illustrated.—Pepper and Tobin's Improved Apparatus for Illusory Exhibitions, with illustration.—Drilling Tube Plates, with illustration.—Art Notes.—Chemical Notes.—Telegraphic Notes.—Practical Hints.—Balloon Ascents, with large illustration.—The Lathe and its Uses, illustrated.—Horstmann's Gauge, illustrated.—Van Choate's Submarine Telegraphy.—Correspondence.—Price Lists.—Contracts, and many original and selected articles of value, alike to the amateur in Science and Art and the Working Mechanic.

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The English Mechanic,
AND
MIRROR OF SCIENCE AND ART.

FRIDAY, FEBRUARY 9TH, 1866.

LATERAL EXTENSION.

THIS much abused expression is, in the matter we are about to treat, a most expressive one—in fact, is *the* expression, which the communication hereto appended will sufficiently explain. We may state our belief here that never before, in the history of class journalism, was such kindness extended to an editor by his readers, in the form of wishes and suggestions, as has been and continues to be extended to us, and we trust we are not the folks to forget it. The letter we refer to is as follows:—

Sir,—I have taken a very great interest in your paper from its first number, and would, with pleasure, promote its prosperity as far as my humble means will allow. In reading your last impression, I think you have taken a wise and prudent course to extend its circulation. If you think well to forward me a few copies, as you suggest, for distribution among my fellow-workmen, I will do so heartily and cheerfully. In an establishment like ours, it cannot help but to do some good.

While I have pen in hand I wish to make a suggestion to you. I think if my fellow-workmen throughout the length and breadth of the land were to subscribe their mite towards a fund for the express purpose of offering suitable prizes for the best essays upon our present and future condition as mechanics; as well as upon our sciences and arts, those essays to be the genuine production of our mechanics I think it might stimulate to the production of some excellent papers. It would bring out ideas and greatly add to our limited stock of knowledge; and I hope would benefit us both socially and morally.

If you think it worth your notice, I am ready at any time with my mite, for this or any other object, where my fellow-workmen's interest is at heart.

Wishing you every success with your undertaking.

I am, &c.,

JOHN SHAW.

Just as received we print Mr. Shaw's communication. The suggestion alluded to has been noticed by several and acted upon; and we have sent and continue to send the copies referred to, to localities where our paper is not known, except to the few. We are perfectly aware that such men as our correspondent is will not abuse our confidence—in fact, we have yet to find a person of that class among our readers.

As to the suggestion anent the essays, that we leave to our readers. They are those principally interested in the matter; their welfare is concerned; and we shall be most happy to contribute towards it, whatever shape the contribution may take. Let them think the matter over well, first; then forward the result of their deliberations to us, and from those communications we can readily tell to which side opinion tends.

LABOUR PROSPECTS.

MONEY is going up—the trade with America is going down—foreigners are underselling us—and now what shall we do? Some timid individuals connected with the press have been amusing themselves, and us, recently, by playing on this three-stringed instrument, to a tune with a lot of variations, and have for once succeeded in arousing attention to their lugubrious chant. They point to the Bank rate of discount—to the price of money in New York, and the nature and quantity of our imports from the great republic across the water, and then they wind up by giving a few instances in which some orders have been secured by continental houses for English requirements. It is not our intention to show why the Bank rate goes up and down—how far it is affected by continental money wants, and rates of exchange &c.; nor to show how it is the trade with America does not, and cannot all at once leap up to the high figure it achieved before the Civil War; but we do mean to say a word or two on why we have but little reason to be afraid of competition with foreigners, knowing at the same time that Mr. Gladstone will have about two millions in hand when he makes his statement.

The prices of materials are going up all over the Continent; in France within the last few days the increase has been considerable, and workmen are getting more money because their services as skilled workmen are becoming more valuable and in greater request. In fact, we know that several contracts have been carried away over the heads of French competitors, within the last few days, by English houses, and other contracts remain "open" because the orders cannot be put in hand at the reserved figure. As free trade extends, and the fear of war abates, continental capital ventures forth, and all the busy industries that swarm from Rotterdam to Prague reap the benefit. An immensity of work is being opened up between those two limits, which will keep all hands thereaway engaged for many a day to come—ay, and leave a margin for a decent picking or two for English, Scotch, and Irish houses; and it *is* a real pleasure to recognise Irish handicraft competing with German and French in France and Germany. Russia, again, is opening out, as the consignments from its neighbouring states and from ourselves amply testify. Italy is showing ahead manfully; and it is notorious that the trade to India, China, and Japan, large as it is, is nothing to what it will become, properly nursed and not overweighted. For in all cases, as "sporting" folks would say, judicious jockeying is a fine paying accomplishment. Again, it is believed that the measures which will be carried out with respect to the Sister Isle in the Session of Parliament just ushered into being will tend very much to restore confidence to those who are willing to embark capital in that section of the Kingdom so highly blessed by Nature; and that again means an accession of work to the English mechanic. The war, if it may be dignified with that name) is fast dying out in New Zealand, this will give an impetus to our trade thereaway; and there is no doubt that best part of the new Queensland loan will eventually find its way back here—if it goes out—in payment for consignments in respect of public works, &c. As for Australia, we know how the trade there stands, and that we have no reason to fear a falling off.

If we look at home, at the immense works projected, and being carried out, there is still further reason found for crying down the craven-hearted chant of that section of the press we have almost dignified by mentioning here.

No, there is no reason to fear, if business be conducted in a calm, keen-eyed manner, that we shall have much cause to grumble; provided always that the rude blast of war be not heard. We do not see much reason to fear this, the political horizon seems pretty clear just now; and we trust that the clang and roar of the hammer and forge will soon utterly drown the savage howls of the dogs of war all over the world.

ACCIDENTS IN MINES.

III.

IT was promised in a preceding paper on this subject,* that explanations should be given of the various modifications of Mr. Ansell's ingenious apparatus for the detection of fire-damp in coal and metalliferous mines. That promise we shall now endeavour to redeem, but before doing so it will be necessary to refer briefly to the law of gas diffusion, as long since discovered, but more recently illustrated, and described minutely by Professor Graham. According to this latter authority all gases appear to be formed of minute atoms which have a natural motion among themselves—rapid or slow—in proportion to their several densities. The atoms of gases are not arrested in their movements by the interception of porous substances, and such substances are Indian rubber, artificially prepared graphite, unglazed earthenware, &c., &c. The laws which govern mixed gases are of a totally different character to those which operate upon liquids. For example, the latter are found to arrange themselves in layers, in exact accordance with their relative specific gravities—the heaviest finding their way to the bottom, and the lightest, theirs to the surface of the vessel in which they may be deposited. From this fact deductions were drawn to the effect that the law of gravitation and not that of any chemical action governed the disposition of mixed liquids. Gases, however, although they may vary greatly in density, are not thus separated, but incorporate themselves immediately by force of diffusion and produce a single gas, so to speak of one uniform density throughout. Carbonic acid gas is twenty-two times heavier than hydrogen. Yet it readily ascends through it, intermixes intimately with it, and a uniform compound gas, perfectly homogeneous, is produced. Further elucidations of the beautiful and extraordinary law of gas diffusion might be introduced, and it could readily be shown that the action of that law regulates the condition of the atmosphere we breathe, correcting inequalities arising from local disturbances, and rendering it capable of sustaining in health all animal and vegetable life. For our present purpose it is not essential to pursue inquiries in this direction, but it must be said that to his perfect acquaintanceship with nature's admirable system of diffusing gases, we are indebted to Mr. Ansell's plan of detecting and recording the existence in mines or elsewhere of the deadly carburretted hydrogen, or fire-damp.

* Vide ENGLISH MECHANIC, January, 1866.

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It has been stated that the primitive mode of discovering the presence of the poor miner's enemy was that of applying a naked candle to the suspected part of the working and observing the changing colour and length of its flame. The danger incurred by resorting to such a course is obvious, but it is to be feared that in some of the mining districts of South Wales it is still pursued. The covered light of the Davy and Stephenson lamps is better, but this too is inadequate and uncertain, as fatal experience day by day demonstrates; and as witness the very recent accidents in the Gethin and Wigan Collieries. To avoid the risks run by the use ofimperfect media, Mr. Ansell devised his fire-damp indicator, and this, in its simplest form, consists of a globe of thin india-rubber—such as children amuse themselves with—mounted on a brass disc with a regulating thumb screw below, and a tiny and accurately balanced lever above, the balloon. A strip of cloth securely bound around the latter effectually prevents its lateral distension, and ensures that any effort of internal pressure shall be exerted vertically. Over the india rubber globe and so arranged as to be disturbed at once by any alteration in its size, is placed a train of clockwork, which, when so disturbed, rings at once an alarum. These are the main features of the contrivance; minute details we need not trouble our readers with, as they have already appeared, accompanied by illustrations, in No. 21, Vol. I., of this journal.

Now, allowing that this miniature balloon is filled with atmospheric air on the bank, and then is carried into the gallery of a mine, and remembering that gas diffuses through the minute pores of india-rubber as readily as if no such septa intervened, it will be at once understood how its action takes place. If the air in the gallery has been made by ventilation to approach in purity that on the surface, no change will be manifest in the dimensions of the globular indicator, but, if on the contrary, poisonous gas be present, it will at once find its way through the india-rubber walls of the contrivance, causing them to expand—air being diffused outwards at the same time—the lever will be lifted, the clockwork released, the bell rung, and the miners warned of their peril!

These things happen immediately that the quantity of fire-damp present exceeds five per cent., or may be made to do so, even before that extent has accumulated, if that be desirable. As fire damp, weight for weight, far exceeds in volume ordinary atmospheric air, it cannot fail to be comprehended that its natural diffusion into the balloon must cause the expansion of the latter and the alarm is given to which we have just referred to. Why so simple, so sensitive, so effectual, and so inexpensive an apparatus has not been introduced into every coal pit in the United Kingdom and into every metalliferous mine it is difficult to conceive. Perhaps that question may presently be put in the House of Commons. At least it should be so put, for the lives of hundreds, perhaps of thousands, depend upon the answer given to it. Mr. Ansell, however, has not rested contented with devising *one* form of indication—he has constructed several, and although each modification of it is influenced and governed by the same law, each has its peculiar excellence. One in particular may be mentioned, and it is his portable fire damp or coal gas detector. In form this resembles an aneroid barometer, and it may be carried in the pocket without more inconvenience than would be caused by one of the obese watches of our grandfathers' days. An inspector of mines furnished with one of these might therefore penetrate into the recesses of a mine, and by the dim light of a "Davy" or "Geordie" lamp, read from its indexed face the amount of gas present. The aneroid indicator consists of a brass case, fitted internally with a small cylinder and piston. The back is composed of a thin plate of unglazed earthenware, and there is a small valve readily opening to the outward air or closed against its actions. Charging the indicator with pure air first, and thus carrying it into a tainted atmosphere, constitute all that is necessary to put its indicating hand in motion. The gas diffuses at once through the porous plate, presses upon the piston with more or less force—in accordance with the percentage existing—moves it along the cylinder, carrying with it the hand of the aneroid, which again registers the exact amount of gas surrounding the instrument. Three other applications of the same principle for the same purpose might be described did space allow; but sufficient we trust has been said to awaken interest in the invention, and to induce mine-owners, colliery managers, and others to give it a fair trial. The dreadful catastrophes at Gethin and Wigan, which resulted entirely from explosions of fire damp, and which have destroyed the lives of seventy odd men and boys, furnish powerful arguments in favour of the introduction of other and more efficient agencies for saving life than at present exist. Would that the legislature would take the subject generally in hand, and appoint another commission composed of really practical, scientific, and unprejudiced members, to examine into and report upon mining economy, in its mechanical, scientific and social phases. Then we might hope that improvement would eventuate, and feel certain at least that those who seek to effect it would be encouraged instead of being treated, as they now too often are, with apathetic indifference—if not silent contempt. It may be that we shall return ere long to a further consideration of the subject, for it is by no means exhausted, but demands rather persevering investigation and unremitting exertion until the desired end be attained. Joseph Newton.

THE PATENT OFFICE INQUIRY AND ITS RESULTS.

Those of our readers who are interested in the stability and proper management of the Patent Office will have heard with a feeling of pleasure that the final report of the Commission appointed to inquire into its condition and management has been printed and is now before the public. The inquiry has been a lengthy one, and the final report is long. We will only extract those parts of it, however, which are of any interest to the reader of the English Mechanic.

The charges against Mr. Edmunds and those by Mr. Edmunds against Mr. Bennet Woodcroft, were particularized in the directions given to the Commissioners as special subjects for investigation. The action taken by the Government in respect to the Edmunds' "affair" has done away with any necessity for pursuing that branch of the inquiry. No evidence was forthcoming against Mr. Woodcroft, and so the charges fell to the ground, though they were investigated by the Commission.

The Commissioners affirm their opinion that the value and importance of the Patent Office have not been duly appreciated, and that the time has come when it ought to be put upon a different footing, respecting which there cannot be any doubt. The Patent Office establishment has always been treated as consisting of two divisions, called respectively "The Patent Division," and "The Specification Division." The reporters remark upon the misfortune that a person so unfit as the late Clerk of the Patents should have been placed at the head of the offices, and that if there had not been several officers of ability and energy in the Patent Office who exerted themselves to the utmost to carry into effect the "new statute," the public would have derived little, if any, benefit from the change of the law effected by the Act.

The Commissioners consider that the establishment "imperatively requires to have the superintendence of a superior officer having the knowledge and skill requisite to enable him to direct and control every department of it, according to the provisions of the statutes and the regulations of the Commissioners (of Patents). We think that such an officer should give daily attendance at the office (except during the ordinary vacations), and that his salary should not be less than £1,500 a year." They consider that the office of Clerk of the Patents, performing his few duties by deputy, as Mr. Edmunds did, ought no longer to exist, and that the office of Clerk to the Commissioners, as it existed in the hands of Mr. Edmunds, is useless, and ought to be abolished. They therefore recommend that the offices should be done away with. The Patent Office should (the reporters think) be made not only the office of the Commissioners of Patents for Inventions, but also an office of the Court of Chancery.

Concerning the "Patent Division" of the office, which used to be superintended by Mr. Ruscoe, as Mr. Edmunds's deputy, they think that the chief clerk "should be a person of skill, who could at once give to the law officer in every case the information necessary to enable him to determine whether the provisional specification sufficiently describes the nature of the invention, and whether the invention is a manufacture, or an invention for which a patent ought to be granted; and whether that information should be furnished to the law officer in the shape of a report, by the chief clerk, accompanying the provisional specification referred to the law officer for consideration. If this were done, we think that the grants of patents for frivolous inventions would in many cases be prevented, and more definite information would be obtained respecting the nature of inventions sought to be patented." The proposition is a very common-sense one, and has been recommended over and over again. But, we must add, we want less of law, and more of real business logic. The appointment of additional clerks is also recommended, as also the favourable consideration of the claims to increased remuneration made by those now in office.

The reporters also think the preparation of copies of patents for transmission to Dublin and Edinburgh is a valueless system, and causes an unnecessary expenditure; and they say in closing this section of their report:—"It appears to us to be desirable, if practicable, to grant no patent for an invention until the applicant has actually filed in the Patent Office an accurate specification, containing clear and distinct claims of invention." It appears that much of the work, and expenses in this division, are occasioned by the imperfections in specifications and specification drawings, and the copies of them, which the patentees are bound to furnish. "It is very desirable," says the report, "that persons who thus occasion extra work to be done in the office should be made to bear the expense," and it is recommended that a deposit be required from each, from which, where necessary, to draw for the extra expense.

In the Specification Division, it is believed, six other clerks are wanted. The permanent clerks have urged their claims for an increase of remuneration, and the Commissioners recommend them for favourable consideration.

One class of supernumerary clerks employed are called "writers," such as are usually employed by law stationers. They have been employed since 1852, and are paid according to the work they do, or the number of hours they are occupied. The following exposure is made of a system pursued in respect of these clerks, under the *régime* of Mr. Edmunds, and his deputy, Mr. Ruscoe. It should be premised that "imprest money" is cash advanced by the Treasury for current expenses in the office:—"Instead of paying the remuneration to these writers out of the imprest moneys, the late Clerk of the Patents and his chief clerk, Mr. Ruscoe, managed to have all these writers paid by Mr. Ruscoe's uncle, a law stationer, who charged the usual law stationer's profit, viz., 50 per cent., upon the sums which he so paid; that is to say, at the end of every half-year he charged the office with £150 for every £100 which he paid to the writers, although the amount of the imprest moneys received from the Treasury at the commencement of the half-year was paid over to the law stationer. This appears to us to have been a most unwarrantable waste of public money. These writing clerks, we have been informed, were not all of them supplied to the office by Mr. Ruscoe's uncle, the stationer, nor was he in any way responsible for the performance of their duties."

Concerning the library, which has existed since 1855, the report says that, since the public are bound at their peril to take notice of patents for inventions, they ought therefore to have the means of ascertaining with facility what the specification of a patent describes and claims as soon as possible after the filing of the specification. How much this accommodation is wanted, let those say who have to make a search.

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The expediency or necessity for the extension of the Patent Office Museum is believed by the reporters to be an idea entertained by many of the most eminent persons, both in town and country, as well as by the scientific gentlemen who have already presented a memorial on the subject. The museum ought, the Commissioners think, to be in the same building as the Patent Office (it has been exhibited hitherto in South Kensington). The fees (now paid in the shape of stamp duties) annually amount to a much larger sum than has ever been expended for the expenses of the office. The report concludes with the following :—

"*These fees were not made payable for the purpose of raising a public revenue, and we think that not any of them ought to be allowed to form part of the general revenue of the country, until the accommodation, expenses, and due working of every department of the Patent Office have been amply and liberally provided for.*"

We print this in italics, as it most emphatically expresses the opinion, not only of ourselves but of every correspondent who has favoured us with an opinion on the matter.

We trust to find every recommendation carried into effect; and that that old and faithful servant, Mr. Woodcroft, may come in for a share of the good things proposed. This gentleman seems to be a universal favourite, and in an office where there is so much civility displayed—so much of the desire to oblige one—this is saying a good deal.

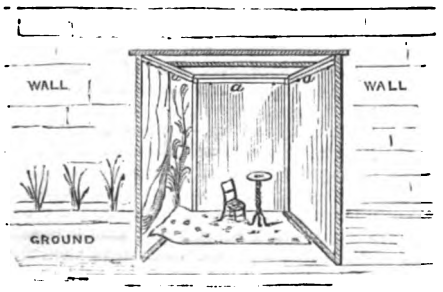
The Commissioners have our best thanks for their report, which does not mince matters, but goes square at the whole concern.

PRACTICAL PHOTOGRAPHY.

VI.

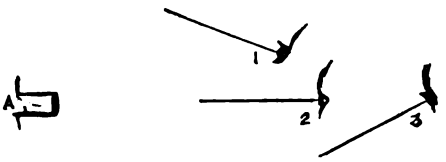
The amateur may at first find it difficult to secure anything like a good portrait from the want of some suitable arrangement by which to place the sitter in the most convenient position. The effect of light falling on the head is to give it a bald appearance. Sunlight shining on the face or clothes distorts the countenance or imparts a patchiness to the garments. Many are the shifts and contrivances which may be resorted to with some prospect of success, such as an umbrella suspended over the head of the sitter, or a clothes-horse and towelling. Trees, bushes, or an arbour, do well in some positions.

But the way to save trouble in the end is to use a little ingenuity at first. Some such arrangement as the following may be erected at a comparatively trifling cost. Against a wall a



framework of deal or ash. The wood in lengths of about 3 in. by 2 thick will be sufficiently strong. Nail and clamp them well together with hoop iron. Let the dotted line A be a stretched wire or cord round the three sides, leaving the front quite open. Cover the top with a sheet; the sides with sheets, blankets, travelling rugs, in fact, any coloured material you may choose to select as a background, suspending them from the cord A. Lay down a piece of floor-cloth, this need not be large, place the camera in position and see how much ground will be taken in—that will give you the size. Of course you will add chairs, tables, or any other little addenda. If the frame-work is placed against a wall on which trees are trained, the sheet drawn back on one side to show a plant or two, will have a good effect. At first you may set aside any idea you may have possessed previously of taking sitters with blue eyes, or wearing spectacles. Babies and animals are also trying subjects. Try to understand the character of the sitter, let everything be perfectly easy, no hurry or bustling about. Head-rests are disagreeable things; they constrain the sitter and sometimes bother the operator. If your sitter cannot hold his head steady for so short a time, it would be better for you to practise on some one else at first who can.

The eye is the object to be focussed, so as to get a sharp picture, and take care that the sitter looks at something in easy range, or the effect will be unnatural. For example—let A be the lens, and



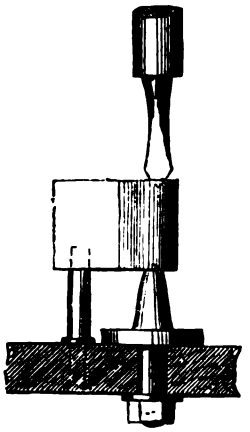
1, 2, 3, represent the eye at different angles, then 1, on devoloping, will assume, perhaps, any idea, from a stare to an appearance of devotion. On the other hand, 3 will demonstrate an attempt at humility, or it may be merely a frown, the lower part of the face, too, will be in shade, while in the first case it will be too strongly lighted. Be careful not to take a sitter with his knees directly in front of him—keep your camera square for perpendicular objects, and be careful that the sunlight does not pour down between the sitter and the camera, or the picture will have an appearance of mist over it. The background must be adapted to the sitter, even if it be of the plainest description or a simple colour. For instance, an old man with white hair will look absurd if taken with a sheet for a background, the head from the eyebrows upward will be scarcely distinguishable or *vice versa*. Windy weather is very annoying, especially where trees or shrubs are included. A moving branch or twig deteriorates from the appearance of the picture exceedingly. Gnats and flies are taken on the plate in the form of minute crosses, *** but bear the appearance of dust marks, unless examined with a strong magnifying glass. The specks so caused are too minute to come out in printing an ordinary picture. Be careful not to leave the camera about, either out of door or in, a fall easily happens, and a cracked camera or broken lens is a sad lesson. Portraits are easily taken in a well-lighted parlour, observing that *both* sides of the sitter are well illuminated, otherwise, on developing the contrast will be almost *extreme*. Occasionally, but not very often, nothing can be taken satisfactorily, from that remarkable cause, a want of sufficient actinism. Let no one handle your plate, not even your friend, till after it has been varnished, and not even then with impunity, a scratch or chip cannot be replaced.

A plain wet plate may be carried in the dark slide for about five minutes to take a distant object, provided the day be not very warm. Sometimes an iron deposit will occur in the developing, but some very good pictures may, nevertheless, be secured.

A CARBON COMPOUND SENSITIVE TO LIGHT.—Dr. F. Gottschalk has found that graphitic acid is sensitive to light, the minute yellow crystalline scales of which the acid consists blackening very quickly when exposed either to direct sunlight or to diffused daylight, or to any powerfully actinic artificial light. It is possible that the discovery may lead to that of some simple and satisfactory process of carbon printing. One of the chief difficulties in the way arises from the exceeding slight solubility of this singular body, which dissolves in water and alcohol only in very minute quantity, and not at all in any other menstrum that has yet been tried. Small, however, as is the proportion of it which will dissolve in water, paper soaked in its aqueous solution becomes reddish brown on exposure to light, any parts of the paper which may be protected from the light remaining quite white.

SIMPLE METHOD OF HOLDING ARTICLES WHILE BEING DRILLED.

The simple apparatus shown in the accompanying figure affords a ready means for fixing on the drilling machine any light articles which it is required should be drilled with accuracy. It consists merely of a conical point, furnished with a base by which it can be secured to the table of the drilling machine, and placed so that it is concentric with the drill spindle. The article to be drilled is marked with a centre punch on each side, at the points where the hole is to commence



and terminate, and is then placed between the conical point just mentioned, and the point of the drill, as shown in the sketch. When the hole has been drilled partly through, the article should be reversed, and the hole completed from the other side, so that the lower point may not be injured by the drill. Holes for the pins of hinges, and long holes through the various parts of brasswork, can be readily drilled in this manner, the method of holding insuring perfect accuracy. The article is prevented from turning round by a pin inserted in the table of the machine, in the usual way, and arranged so as to catch against any projecting part of the object being drilled.—Extracted from *Engineering*.

CONDENSING THE FUMES FROM FURNACES.

There is not the slightest doubt but that the Parliamentery interference in regulating the health of towns, so far as making it an offence to void into the atmosphere noxious fumes from factories, has been a great boon to the inhabitants of manufacturing towns, and of profit to the manufacturers, who at one time considered Parliamentary interference as most unwarrantable impertinence. This is but another proof that it always "pays" to do the right thing—either morally or socially. The utilisation of noxious fumes—converting them, by certain operations, into tangibilities, and thence into hard cash, has afforded great scope for inventive talent, and continues still to do so. A goodly number of patents are evidence of this, though several inventions fall through ere they pass the "provisional protection" stage. Among these is the one we are about to summarise, which had its author in Mr. Watts, of Birmingham, a metal refiner, and its purpose was to condense and collect products volatilised in furnaces. We give the matter as a guidance to others in the same groove. In respect to furnaces for mixing or melting copper and zinc—in situations where there is sufficient room for the purpose, the ordinary chimney is proposed to be dispensed with, substituting therefor a closed culvert, connected with a chamber containing a revolving fan, by means of which fan the draught is produced through the furnace. The waste gases from the furnace are directed by the fan blast into a condenser, where the oxide of zinc carried in the waste gases is condensed and collected. The condenser is a chamber filled with fragments of coke, kept wet by a stream of water. The waste gases are passed downwards through the condenser, and the stream of water condenses

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and carries down the oxide of zinc. This mixture is received in a reservoir, and the water is separated from the metallic oxide either by filtration or decantation. When one fan is insufficient to produce the blast necessary for the proper working of the furnace, it may be supplemented by another, made to direct a blast from the ash-pit into the fire between the bars of the furnace. Where there is not sufficient room for the culvert, a downward flue may be connected with the top of the ordinary chimney, and the fan blast made to conduct the waste gases from the stack, through the downward flue, to the condenser.

We wish Mr. Watts "better luck next time;" there's room for plenty more patents in this matter, as there are plenty of markets for the products they bring "to bank."

SEWING MACHINERY.

III.

CONSTRUCTION OF SINGLE-THREAD MACHINES.

The feeder is a toothed plate S, secured to one end of a lever T, pivotted to the frame of the machine. The feed plate rises and sinks, and moves to and fro in a slot in the table plate B. It is raised once for each depression of the needle bar by means of the hub K, secured to the shaft H, and has two protuberances *s*, *s*, at its sides, diametrically opposite each other (see fig. 19). The feed bar is depressed by the spring of the arm *j* of the lever T, which acts antagonistically to the cams *s*, *s*, and holds the feed plate out of contact with the cloth, except when it is raised by the protuberances of the cams. To move the feed plate to and fro to feed the cloth forward, and to retrograde previous to each feeding movement, the butt end *j* of the feed lever is fitted with two adjustable wipers *x* and x_1, fig. 15, operating in connection with two cams U and U^1, keyed to the shaft H. These cams acting upon the wipers, move the feed plate in one direction to feed the cloth forward past the needle, and the return movement of the feed plate is effected by a spring *r* applied to the butt of the feed lever. One of the cams U (see fig. 21) has two protuberances *t*, *t*, which project equal distances at the opposite sides of the cam. The other cam U^1 (see fig. 22), has a single protuberance *k* of about double the projection of those of first cam U. The shanks of the wipers *x*, x_1, are screwed through bosses secured to the feed lever T, and pass through holes in the frame of the machine to its exterior, where they are formed into milled heads V, V^1, by turning which the positions of the wipers may be adjusted relatively to the cams which act upon them. The cam U_1 is so set with reference to the cam U that the protuberance of the former is in position to act upon its wiper x^1 at the same time that one of the protuberances of the latter is in position to act on its wiper *x*. Hence, if the wiper x_1 be adjusted by screwing its shank from the cam, so that the cam in its revolution cannot touch it, the feed plate S will be moved by the alternate action of the two protuberances of the cam U on its wiper x^1, and as these protuberances are of equal projection the movements of the feed plate will all be equal, and the stitches will be of uniform length, which may, however, be regulated by adjusting the wiper *x*. If, on the other hand, the wiper x^1 be adjusted by screwing its shank towards the cam, so that the cam U^1 in its revolution acts upon it, the feed plate will be moved alternately by the action of one of the protuberances of the cams U on its wiper *x*, and by the action of the protuberance of the cam U^1 on its wiper x_1, and as the protuberance of the cam U^1 is double that of those of the cams U, the movements of the feed plate will be such that the stitches will be alternately long and short, the lengths of the long and short stitches being regulated by the adjustment of the wipers. The machine is fitted with a standard *x* for the spool of needle thread, a thread tension *y*, thread guides *w*, *w*, and a presser foot Z. The machine is operated by turning the shaft H in the direction of the arrow. When sewing, the needle descends, perforates the material to be sewed, carries the loop through it, presents it to the action of the looper, and rises again preparatory to a succeeding descent. As the loops of needle thread are presented by the needle they are seized alternately by the hooked points of the looper, and are extended by them. The body of the looper is wider than its points, so that as each loop is extended by the revolution of the hook point that has seized it, it is spread laterally, so that the succeeding hook point can draw the succeeding loop of thread through its predecessor, and as the loops are not twisted by this mode of operation the chain of loops forming the under side of the seam, when completed, lies flat against the surface of the cloth. As the backs of the hook heads of the looper extend backwards for a considerable distance, the loop seized by each hook point is not given up or let off until the succeeding hook point has seized and is extending a succeeding loop presented by the needle, and the needle has descended a second time and entered the loop let off. The loop seized at this last descent of the needle is drawn by one of the hooks through the two preceding loops, thereby producing a double-chain embroidery stitch resembling braid upon the under face of the fabric.

When the machine is used for sewing ordinary seams it may be made to produce an ordinary single-thread chain stitch, in which each loop of needle thread is drawn through the next preceding loop alone (instead of the two preceding loops) by substituting the double-headed looper represented at figures 23 and 24, for that represented in figs. 16 and 17. This looper differs from that first described in the form of the hook heads, the backs of which do not extend so far as those of the looping hook first described; hence as the hooked points of the double looper are at opposite sides of the circle described by it the loop extended by one hooked point is given up as the next one is extended, so that each loop of needle thread is drawn through the loop next preceding it, and there need be no surplus loose thread to embarrass the operation of the machine. In using this second looping hook a perforated guard *n* may be placed under the table plate B in such position relatively to the needle that the latter in its descent almost touches the side of the perforation of the guard farthest from the cam I, so that the guard prevents the swell of the loop of needle thread at that side of the needle, and causes it to swell out to a greater extent at the other side than it otherwise would, thereby ensuring its seizure by the hook of the looper.

We have far exceeded the space we had allotted ourselves at starting, but as we went on we found that justice could not be done the various items, and clearness preserved, in less space.

AMERICAN LITHOGRAPHIC STONE.—Mr. S. D. Morgan, of Nashville, Tenn., U.S., states that there is an abundance of lithographic stone in Tennessee, in all respects equal, according to tests, to any from Bavaria or elsewhere.

THE ANEROID BAROMETER.—We have to chronicle a very noteworthy improvement in the Aneroid Barometer recently effected and registered by Messrs. Cook and Sons, the celebrated opticians. Although the Aneroid, under ordinary circumstances, has been shown by Mr. Glaisher and others to be very much more effective and satisfactory in its results than could have been hoped, still under conditions which bring rapid changes of pressure into play the instrument when it returns to the normal pressure does not always indicate correctly. This results from the motion being communicated to the index axle by a chain, and this chain, from other considerations, is the weakest part of the instrument, and is the first acted upon by climatic influences, rust, &c. Mr. Cook has abolished this chain altogether, substituting for it an almost invisible driving-band of gold or platinum, and the result of this great improvement is that the Aneroid may now be looked upon as an almost perfect instrument for scientific research. Several such Aneroids, placed under the receiver of an air-pump, not only march absolutely together, but all return unfailingly to one and the same indication.

FLUTING MOULDINGS.

We have to acknowledge the receipt of the following note from "Rue Fossé aux Loups, Bruxelles," respecting the fluting of mouldings in gilt and other frames:—

In the ordinary process the mouldings made on wood frames previous to gilding are covered with a pasty composition. I propose to make these flutings or undulations by a mechanism which is composed of a bench similar to a turner's lathe, the upper part of which receives a wooden plate, on which are laid the mouldings intended to be covered with the paste, and then to receive the flutings. A carriage, composed of two perpendicular faces in the same direction as the bench, fastened tightly together, moves forward on the bench, having a guide piece attached to one of its sides. A cast-iron beam upon one of these faces passes over the bench, and on this beam is fastened an iron plate cut on its bottom face according to the profile of the moulding upon which it is to be worked. This plate spreads and smoothes the paste, which is run upon the mouldings from a reservoir as the carriage advances. To each kind of moulding to be fluted is adapted an iron plate of the same profile, which is rolled upon the fixed plate in the perpendicular direction of the profile. These plates are propelled by springs against a piece in contact with a wheel fixed on a transverse axis, which, while the carriage is advancing, gives it a rapid to-and-fro motion, forming in the composition a fluting, the distance between the ridges of which is regulated by the number of teeth in the wheel giving motion to the profile. The axis of the wheels turns in a socket at each end over the transverse beam, and its rotary motion is produced by another wheel, which in turn receives its motion from a third wheel running upon a rack as the carriage advances, to which the axis is fastened.

We should have been more gratified had our Belgian friend sent us all of his communication in French; still more so if he had sent drawings of his scheme.

PHOTOGRAPHIC NOTES.

VISCOUS IRON DEVELOPERS. — Mr. Bingham points out that Mr. Robert Hunt was the first to use a viscous iron developer. In the ferrotype process, published in 1844, the developer was composed of gum arabic and protosulphate of iron.

INTENSIFYING PROCESSES.—In former Year-Books we have stated in detail the various modes employed in intensifying. The space demanded this year by various novelties does not permit the repetition of those which have not been modified. We may here remark, however, that one of the features of the various gelantino-iron solutions is their suitability for intensifying where that process is required, as nitrate of solution may be added to them freely without risk of ready decomposition. For ordinary intensifying a few drops of nitrate solution may be added to any one of the gelatino-iron solutions described on other pages, and applied to the plate, when the image will readily intensify. The saccharo-sulphate developer of Mr. Law also possesses the same property. It should be remembered that if a negative seems hard or under-exposed, it should be intensified before fixing, and that any of the gelatino-iron solutions, or a one grain solution of pyro-gallic acid with one grain of citric acid, or a five grain solution of protosulphate of iron with five grains of citric acid—any of these and a few drops of nitrate of solution may be used for the purpose. Intensifying after fixing is best suited to over-exposed thin negatives, and these may be intensified as above described, or sulphides or mercury, &c. Whenever a negative is intensified with one of the solutions to which nitrate of silver is added, whether before or after fixing, it is wise, in order to prevent risk of fog, to heat the plate with a solution of iodine one grain, iodide of potassium two grains, in one ounce of water; this, after remaining on the film about a minute, should be washed. The image will then be more easily intensified, and the risk of deposit in the shadows will be much less.—*Year-Book of Photography.*

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BALLOON ASCENTS.—II.*

(Illustrated on Page 254.)

At 1,000 feet high the decline was 4½°; in the second and third thousand there was a further decline, a little more than 3½° in each thousand feet; this amount decreased to 3° between 5,500 and 6,500 feet, and was less and less in each successive 1,000 feet, till it was as small as 1° in this space at about 21,000 feet high.

Therefore, an average space of 223 feet was passed for a decline of 1° up to the first 1,000 feet, this space becoming greater, till at an elevation of 21,000 feet, the sky being still obscured by cloud, a space of fully 1,000 feet had to be passed for a decline of 18.

Up to 5,000 feet the results are based upon experiments varying from 13 to 22; at 6,000 and 7,000 feet to 7 and 5 respectively; from 7,000 to 16,000 to 4 only; these having been made on two days in 1863, June 26 and September 29, on which days the balloon was frequently enveloped in fog and clouds to the height of three and four miles, and those above 16,000 feet on the former of these two days only, during the ascent and descent; the sky being still covered with cloud, when the balloon was between four and five miles high.

I may here remark upon the fact of passing through clouds situated three and four miles high, and finding clouds higher still. Clouds of a dense character were previously supposed to be always located very much nearer the earth; and to one class of clouds alone, viz., the cirrus, commonly called mares' tails, was attributed elevations at such great heights.

With clear skies the decline of temperature within the first 1,000 feet was 6¼°; in the next, 4¾°; and decreasing continually with elevation, till at 27,000 feet the decrease in 1,000 feet was 1° only. Up to the height of 22,000 feet, the number of experiments had varied from 7 to 17 in each step of 1,000 feet, and there can be but little doubt that the numbers resulting from so many experiments are very nearly true.

The space necessary to pass through for a decline of 1° of temperature, is less than one hundred feet near the earth; averaging 162 feet for the first 1,000 feet, and at heights exceeding 25,000 feet, it is necessary to pass through 1,000 feet of vertical height, for a decline of 1° of temperature.

I have endeavoured, thus far, to give the results for temperature. They differ in both states of the sky from the results found from mountain observations, and, consequently, this value can no longer be used in any physical investigations where needed. Without exception, the fall of 1° has always taken place in the smallest space when near the earth, and the space continually increases the farther removed from the earth.

These results were those based upon summer observations, made when the sun was well up, or during the hours of the day. A question then arose, "Will the same laws hold good in all seasons of the year, and will the laws during the day be true at night in that season of the year?" To answer these questions, experiments have been made in different seasons, and at different hours of the day. It was found, even in summer, that the rapidity of the decrease was checked for some time before sunset, and that, on one occasion, in the month of June, there was found to be no difference of temperature from the earth for 2,000 feet above it; and on another day, in the same week, the change of temperature after the sun had set, was very small up to 3,000 and 6,000 feet. From these results, it seems probable that, for some time after sunset, the temperature may increase instead of decrease, for some distance from the earth; but no experiments have, as yet, been made at night.

The results as found in winter, spring and autumn, do not accord very closely with those found in summer, and therefore all the results cannot, as yet, be combined to deduce general laws. In winter, on January 12th, a stream of air one mile in thickness was passed through of higher temperature than then on the earth. It was a strong current of air, about a mile in height, passing from the south-west, and moving differently from the stream of air on the earth's surface; above this warm stratum the air was very dry, and higher still fine granular snow was falling into the warm air beneath.

The meeting with this south-west current of air, which was watched for several days afterwards, moving in the same direction, what direction soever the wind was below, is certainly of the highest importance to us. It bears directly on our very high mean temperature in winter, so much higher than is due to our geographical position on the earth's surface, and it is very highly probable that to its fluctuations the variation of our winters are due. . . . .

One other fact I may refer to in respect to the circumstance met with on that day, it is the presence of cold snow above the warm air. Such a state of things is quite sufficient to account for the production of any amount of fog. . . .

A useful inference may be drawn from the fact of hot and cold currents of air of different velocities and extent existing at the same time, in contact with each other. Such a state is but a struggle between forces, either of which may preponderate at any moment; and to this cause may be attributed, with high probability, the all but unaccountable changes that so suddenly take place at times during winter, and clearly indicates that how warm soever the weather may be at this season of the year, the warm current of air may be deflected at any moment, and give place to the then dominant cold current, for which we should at all times be prepared. . . .

Respecting the results of the researches connected with the varying amount of water in the air, at different elevations, it may be the most convenient mode to express in the terms of humidity of the air, considering that the whole amount possible at the then temperature be represented by 100, and determining how many such parts were really present—the more or less dryness of the air, at the different elevations, will thus be made apparent—100 showing complete wetness, there being present then all possible, the number 50 will show that one-half only of the quantity of water required for saturation was really present, and so on, extreme dryness being shown by very small numbers.

* The major part of the matter of this article is extracted from a paper in the *Popular Science Review* by James Glaisher, F.R.S.; the illustration is also from the same source.

ANALYTICAL CHEMISTRY.

Messrs. R. P. Beaujen, Professor at the St. Chamond College, and Mine, chemist, presented a note to the Academy of Sciences last month relative to the scales and spangles of iron driven off from iron at a red heat under the rolling-mills. In order to ascertain their chemical composition perfectly, the learned gentleman analysed those from the forge of St. Chamond, the property MM. Dubouchet Brothers, where bands are made for barrel-hoops, and other purposes; this was done to see how nearly the analysis of the scales of the iron used here would agree with the formulæ of Berthier (Fe_2O^3, 4 Fe O), and of Mosander (Fe^2O_3, 6 Fe O). For this purpose they took 1 gramme of the material, which they dissolved in pure chlorhydric acid, and treated the solution with a solution of permanganatate of potash to ascertain the quantity of protoxide of iron. Again, they took another gramme of the scales, which they dissolved in the same manner, reducing the solution by zinc, in order to attain the peroxide of iron. Afterwards a gramme was dissolved in aqua regia, and evaporated to dryness to discover the silica; also, a portion was reserved for discovering the alumina, &c. The results were (as the average of several assays):—

Iron in the state of protoxide	0·241
Iron in the state of peroxide	0·439

Which gave the analysis as follows:—

Fe^2O^3	0·345
Fe O	0·605
Silex, alumina, &c.	0·010
Loss	0·080—1·000

Which gives the formula (not counting the silex and loss) Fe^2O^3, 4 Fe O.

which is the formula of Berthier. The loss of 8 per cent., which was regularly obtained, enabled these learned gentlemen to verify the results of the method by permanganate of potash, by those generally adopted—by the precipitation of the peroxide of iron by ammonia, and by carbonate of soda, in order to separate the phosphoric acid, which frequently enters into the composition of the iron of commerce. This method consists in treating the peroxide of iron with a solution of carbonate of soda. A precipitate is then formed of *basic* phosphate, mingled with oxide of iron, which is melted with carbonate of soda, in order to produce a soluble phosphate of soda, and the pure oxide of iron, which is separated by a filter, washed, and calcined, so as to have the amount of metal. The soluble phosphate is then mixed with chloride of calcium and ammonia, in order to produce the phosphate of lime of bones, whence the phosphoric acid is extracted and noted. The results of the proceedings were as follows:—

	By ammonia.	By carbonate of soda.
Fe^2O_3	0·345	0·345
Fe O	0·646	0·645
Silex, alumina, &c.	0·009	0·009
Phosphoric acid	0·000	0·001 (0·00056)

giving the peroxide 0·241, and the protoxide 0·501, the formula being Fe^2O_3, 5 Fe O.

The specific gravity of the scales was 4·645 (mean of three trials by the phial method); they were attracted by the magnet, and were not formed of two different layers, as Mosander states in his researches.

ASTRONOMICAL NOTES.

A short paper by Mr. W. Huggins, read last week at the Royal Society, furnishes another example of the importance of spectrum analysis in astronomical, and, we may say, cosmical science, inasmuch as it shows the difference between the light of the nucleus of a comet, and that of its tail or coma. A small comet, described by astronomers as comet I. 1866, an oval, nebulous mass, surrounding a small and dim nucleus, has been visible since the beginning of the year. Mr. Huggins got an observation of it on the 9th instant, and from the spectrum produced, though faint, he is able to state that the nucleus is self-luminous, and that, in common with some of the nebulæ, its substance is in the form of ignited gas. The coma, on the contrary, cannot be supposed to consist of incandescent solid matter, and it shines by reflected light in the same way as clouds do. Mr. Huggins believes that cometary matter consists chiefly of nitrogen, or of a more elementary substance existing in nitrogen. Donati, after observing the spectrum of a comet in 1864, remarked that it resembled the spectra of some of the metals—which reminds us that in his lecture "On the Solidification of Gases," delivered some twenty years ago at the Royal Institution, Prof. Faraday stated that in his opinion if nitrogen should ever be solidified, it would prove to be a metal.

The meteor specimens exhibited at Mr. Warren De La Rue's last soiree, were of a rare and remarkable kind. They were seen to fall near Montauban, in the south of France, in 1864, and were quite hot when picked up. In appearance they resemble dried lumps of London mud; but they consist of minute crystals of a rare kind of iron, and of sulphur, mingled with a peaty substance, which is held together by sulphate of ammonia. This sulphate dissolves when a portion of the meteorite is put into water, and the whole mass falls to pieces. Consequently, had a shower of rain fallen between the time of the fall of the meteorite and the picking up of the fragments, they would have disappeared, and have been lost to science, for the disintegrated crystals are too minute to attract notice when strewn on the surface of the ground. It is probable that similar meteorites have fallen in other places, and having, so to speak, melted away in the next shower, left no tangible evidence to the astronomer or mineralogist.

WAGES IN MANCHESTER.—The Lancashire Steel Company, in a circular respecting the prices of files, state that they have accorded an advance of 10 per cent. upon the wages of their workmen.

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TECHNICAL CHEMISTRY.

THE MANUFACTURE OF CITRIC ACID.

By Frederick Row, F.C.S.

As so little attention has hitherto been given to the manufacture of these organic acids by scientific men (probably on account of the small quantity annually produced), a few observations from practical experience may not be uninteresting.

The first point of importance in this manufacture is the defecation of the lime or lemon-juice imported, and from which almost all the citric acid of commerce is produced.

This juice contains, beside the citric acid, a large quantity of colouring matter; mucilage, and other impurities, which in the ordinary method of working so contaminates the citrate of lime next produced as to render the subsequent solution, and also the crystals of citric acid, so impure that repeated re-crystallisation and re-saturation are necessary to render them fit for the market.

Hitherto it seems to have baffled the efforts of manufacturers to overcome this difficulty, and hence the great cost at which the acid is prepared; but the writer of this paper has found that when the concentrated juice is diluted to the same strength as the fresh juice (which contains about twelve ounces of citric acid to the gallon) that a great part of the mucilaginous and other impurities will separate by subsidence in a flocculent form, and the citrate of lime and also the citric acid produced from the juice so purified will be in a state of comparative purity.

Another very important point for consideration of the manufacturer is the way in which the solutions of these acids are evaporated; the sulphuric acid necessary to be in slight excess at first so accumulates in percentage by the repeated evaporation and crystallisation of the citric acid out of the solutions, as to cause a most destructive action upon that remaining in the mother liquors. Various means have been used to prevent this, the most successful being doubtless the substitution of water for steam heat during evaporation, but as the lower temperature requires longer exposure to heat, the advantage thus gained is almost counteracted.

The most effectual means of remedying this is by passing the mother liquors so soon as they are found to contain any dangerous amount of sulphuric acid through a fresh portion of citrate of lime, which not only removes at once all free sulphuric acid contained, but there is also deposited a quantity of flocculent matter which was held in solution by it, and which is no doubt the cause of the mother liquors when old crystallising only with such difficulty. The flocculent precipitate referred to consists for the most part of sulphate of lime, but contains also some phosphate of iron and alumina, and accumulates more or less according to the care bestowed in evaporating the solution, it being most insoluble when the liquor contains about 6 lbs. of citric acid to the gallon, marking 1200 to 1250 (according to temperature) on the hydrometer, and if not separated from the solutions at that point it partly dissolves again as they become more concentrated.

As a consequence of this, it is found necessary, in the usual working, to re-saturate these solutions so soon as they become surcharged with these matters and the sulphuric acid above referred to, and thus renew the whole process continually, which of course necessarily increases greatly the expense of working, as well as loss both in time and material; but when the process of purifying referred to is adopted, it is found practicable to work continuously with the same liquors without saturating (of course depending upon the amount of carefulness in the manipulation), and in such case the cost of production is lessened nearly one-half. The crystals of citric acid also being most tenacious of sulphate of lime will often hold it so as to render them contaminated even to the second or third crystallisation, producing an opacity which when dried gives them an appearance of efflorescence; materially affecting their commercial value.

This difficulty, which is also, in the opinion of the writer, to be overcome, will form part of a future paper.—*Chemical News.*

HOME ACCOMMODATION FOR THE WORKING AND INDIGENT CLASSES.

At a meeting of the department of Economy and Trade of the National Association for the Promotion of Social Science, held at the Society's Rooms, Adam-street, Adelphi, Mr. Chadwick, president of the department, in the chair, the subject of "Home Accommodation to the Working and Indigent Classes in Great Towns" was introduced. There was a large attendance.

Mr. Thomas Beggs, in a paper which he read, dwelt upon the consequences of the present insufficient accommodation for the working classes, particularly in large towns, and referred to the various land and building societies which have from time to time sprung into existence. Coming to the freehold land and building societies, Mr. Beggs said—"I believe that here is the power, in an advanced stage of development, that will meet to a large extent the evil of defective dwellings and overcrowding in our large cities. These societies have originated among the people, and to a considerable extent have been supported, and, in some degree, have been managed by them. Leasehold houses are generally built upon leasehold land, and the tendency is to carry a system of scamping through the whole operations. The interest of the builder is temporary and not permanent. As a corrective to this and many other evils springing from it, I wish to give facilities to all classes to become proprietors of their own houses, having the house and the land upon which it stands in one freehold."

ANTHRACITE USED AS MEDICINE.

Dr. N. Dyes, chief medical officer of the Hanoverian regiment of the Hussars of the Guards, at Verden, having remarked that pigs eat coal with much avidity, took the idea of adding a certain quantity of this mineral to the food given to fatten them. He gave to some of them from three to six drachms per day, and remarked that these were noted for their liveliness, good appetite, growth, and rapid increase of flesh. Having repeated the experiment on several occasions, Dr. Dyes came to the conclusion that in the fattening of pigs anthracite is, for the greater number of these animals, superior to common salt as a means of quickening digestion and maintaining general health; that it constitutes a preservative against the catarrh of the stomach and intestines, as well as against cholics, and that it prevented all the maladies which result from impoverishment or thinness of the blood; also that coal exerted a favourable action on the liver, spleen, &c. Perfectly convinced as to the correctness of his observations, Dr. Dyes did not hesitate in administering coal to persons attacked with abdominal complaints, and chose for that purpose the Piesberge anthracite, which is found in great quantities in the neighbourhood of Osnabruck. He obtained invariably and rapidly the best results from the employment of this mineral, which had not in any case produced the slightest evil effect. For two years Dr. Dyes has employed anthracite in a number of abdominal affections, and obtained such remarkable results that he declares that it cannot be too much recommended in catarrhs of the stomach or cramps, and a host of other maladies which are usually treated by coal tar or charcoal. For diseases of the skin he prefers anthracite internally to coal tar externally. Dr. Dyes gives in fine powder 15 to 30 grains per day, incorporated in some convenient pulp, or in pills. There is nothing extraordinary in all this, when we consider that anthracite contains carbon 0·90; hydrogen, 0·03; volatile matters (sulphur), 0·03; ashes, 0·04, in 100 parts.—(*Analysis, Berthier.*)

Artificial Light.—M. Sayers, of Paris, has found that a brilliant light, possessing very high actinic power, is produced by the combustion of a mixture of twenty-four parts of well-dried pulverised nitrate of potash with seven parts of flowers of sulphur, and six of the red sulphide of arsenic. This mixture can be sold at threepence a pound, and its light is therefore much cheaper than that of magnesium, to which it is said to be only very slightly inferior in actinic energy.

SCIENTIFIC NEWS.

Artificial Ivory.—An American patent has been secured for a composition of bone-dust with certain other ingredients, whereby said bone-dust is bleached and transformed into a pliable mass, which can be readily pressed into moulds of any desired description, and from which billiard-balls and other articles can be made equally as hard and durable as such balls or other articles made of real ivory.

M. Berthelot has reported to the Academy of Sciences at Paris an account of the formation of the luminous hydro-carbon acetylene, during incomplete combustion. This gas hitherto has only been produced when the organic bodies from which it is derived have been submitted to a red heat. He states that, in reality, the combustion of hydro-carbon compounds is not effected at once, but is the consequence of a series of decompositions. The first of these decompositions gives rise to special products; then follow the general products formed in all combustions which precede carbonic acid and water. Hitherto carbon and carbonic oxide have been regarded as the only general products of this kind; now, acetylene must be added to the number.

The conclusion of M. Emile Kopp's important memoir on the utilisation of the residua of the manufacture of chloride of lime and carbonate of soda, presented to the Chemical Society of Paris, is printed in the monthly *Bulletin* of that body. It contains detailed descriptions of the apparatus employed, and tables of the results obtained. An abridged translation of this memoir is in the course of publication in the *Chemical News.*

PROGRESS OF INVENTION.

The largest wire rope probably ever manufactured, was recently turned out from the wire factory of the Messrs. Hazard and Co., Pittsburgh, Pa. Two of nearly equal length and size were manufactured. The largest lacks but 80ft. of being a mile in length, is 1 5-8th in. thick, and weighs upwards of 11 tons. It is to be employed on the Canal Company's plain, near Wilkesbarre, Pa.

Oil and Coke from Coal and Slack.—Mr. J. Nicholas, of Aspull, near Wigan, proposes to produce oil and coke from coal and slack, and from condensable vapours. The oven should be capable of being made steam-tight, and at the top are two apertures, one communicating with a condenser and the other with the air. The oven is charged in the usual manner, and the draft-holes and all apertures are carefully closed, with the exception of the aperture leading to the condenser. The products are condensed and purified in the usual manner.

A New Light for Ships.—The Prefect of the Seine-Inferieure has just published a new regulation respecting the mode of lighting the boats which navigate the Seine. It has been found by experience that the lamps with silvered reflectors hitherto used dazzled the eyes of the pilots so as to prevent them avoiding collisions. A new lamp, invented by M. Chretien, of Rouen, combining a silvered reflector with a porcelain objective, has recently been subjected to many experiments by the Government engineers, and found to answer perfectly. The prefect has therefore ordered this kind of lamp to be henceforth used on all boats navigating the Seine within his jurisdiction.

Improved Turbine.—An invention has been brought forward by Mr. George Talcott, of New York, the object of which is to obtain a tight joint without causing friction, and to this end a flange is attached to the inner edges of the scroll, helix, or box, either at the top or bottom, or both; the said flange being of such a shape as to form annular boxes in which water, when the wheel is at work or in motion, is retained directly over the joints by centrifugal force, generated by the rotation of the wheel, and loose joints admitted, which will not cause any friction, and at the same time prevent the escape or leakage of water therefrom.

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ON PURE WATER.*

By EDWIN LANCASTER, M.D., F.R.S.

(*Concluded from page* 252.)

Of the various forms of contagious fever which attack the inhabitants of this country, there appears to be little doubt that the fever known as typhoid fever is propagated by means of water. Whether this fever can be produced *de novo*, by poison in water or in the air, is still a question amongst medical men; but that occasional epidemics of this fever are produced by drinking water there is no doubt in the minds of medical inquirers. Dr. Budd relates the instance of a ball at Cowbridge which was attended by from ninety to a hundred people. Of these more than one-third were laid up with typhoid fever. In this case there was satisfactory reason to believe that the water served at the ball was contaminated. Numerous instances, showing the occurence of this disease in families after drinking impure water, are recorded, and there can be little doubt that it is one of the forms of disease that is propagated by the agency of impure water.

Another set of diseases are malarious fevers, which are known to be produced by drinking impure water. I might add a long list of other diseases which, on competent medical authority, are known to have originated in impure water. I will only allude to the attacks of parasitic animals. It is well known that various creatures inhabit the human body, especially the class of worms. A large number of worms pass their cystic or larval stage in the bodies of other animals. The eggs of these creatures are, in the majority of instances, intrduced by the agency of water. Amongst the contents of impure waters the microscope reveals the eggs of the entozoa, and there can be little doubt that the germs of cystic worms and hydatids are introduced into the human system by the agency of impure water. I hope, however, that I have said enough to show how necessary it is for our welfare that pure water should be supplied for daily use, and I have now to speak of some of the practical measures that should be adopted for the supply of pure water. This question naturally divides itself into the public supply of water to towns, and the private supply of families.

With regard to public supplies of water, it will be seen that water neither from rivers nor springs is certainly pure. When water is taken from a river to supply a town, especially when the river receives sewage, every precaution should be taken to reduce the organic matter to the lowest possible quantity. It is undoubtedly desirable in a country like our own, where such large masses of the community, as in London for instance, must depend on water from rivers, that the legislature should pass some stringent Act, forbidding the diversion of the drainage of our large towns into rivers at all. When it is recollected that this must eventually be a gain to the country, by compelling the deposition of the sewage in the soil, where it must necessarily become a source of wealth, it is to be hoped that there will no longer be supineness or ignorance enough to prevent legislation on this very important subject.

But even water from springs may be contaminated. Springs are often situated in highly cultivated agricultural districts, among populations utterly negligent of the distribution of the watercourses that flow through them, and may thus reach the population which they supply with water highly charged with organic matters. It is only by proper filtration at the works, by which the water is supplied to towns, that danger can be obviated, either in the case of water supplied by rivers or springs. It is a consolation to know that through the care and intelligence exhibited by a large number of our water companies, water is now supplied to many of our large towns of an unexceptionable character. This is remarkably the case in London, where the water of the Thames, receiving the sewage of several large towns in its course, can nevertheless be supplied in a state of purity, which will bear comparison with most other large towns in England. It is necessary that a vigilant eye should be kept on the nature of this supply, and in London we are undoubtedly indebted to the monthly analysis of water supplied by the Thames companies, published by the Registrar-General, for the maintenance of the integrity of our water.

There are, however, large numbers of the population who are not within the reach of our public supplies, and who are obliged to have recourse to pumps and wells, ponds, rivers, and ditches, for the water which they drink. Such persons cannot be too cautious in the employment of the water they are compelled to take. Wherever water is of a doubtful character, then filtration should be had recourse to. The filtration of water can be effected by passing it through sand, pebbles, sandstone, sponge, and charcoal. Of these agents, charcoal is most efficient. Filters made with charcoal are now manufactured on a large scale, and are, in most instances, efficient means of rendering impure water pure. Such filters should be employed when waters are of a doubtful character, and only filtered water should be used for drinking purposes.†

Where, however, filtered water cannot be had, it should be known that one of the most effectual means of purifying water is submitting it to boiling. This does not get rid of all its inorganic constituents, but it effectually destroys organic matters. It is undoubtedly insipid (which may be obviated by passing it through a gazogene), but it is better to drink the most insipid of water, than run the hazard of drinking water charged with organic impurities.

When water is otherwise good it may be rendered impure by the carelessness and indolence of those who use it. Thus a water, which drunk when first drawn from the cistern, pipe, or well in which it stands is perfectly harmless, may become injurious by standing for days in the same vessel. It frequently happens that water-bottles, pitchers, and mugs, in which water is habitually kept, are never cleansed, and the daily deposit of organic matter at the bottom will at last become so great as to render the water putrid. It is in this way, by the negligence of servants and others, that water otherwise free from objection are found to become tainted, and I have known attempts made to cast doubt on the quality of the whole supply of a town from individual cases of neglect and ignorance.

In these remarks on the purification of water, I have more particularly directed attention to the removal of organic impurities, as those which are most injurious to health. I would, however, refer to the fact that, when waters contain a large quantity of carbonate of lime, which is always held in solution in carbonic acid, this salt of lime may be got rid of by neutralizing the carbonic acid with pure lime. This process, originally suggested by Dr. Clark, of Aberdeen, has been successfully employed to soften hard water, and may be advantageously employed, both for removing the orgrnic impurities as well as the carbonate of lime.

It should also be remembered that storing water in leaden cisterns, and conveying it through leaden pipes, may lead to a dangerous contamination with lead.

The interest of the public in pure water is not alone confined to its use as an article of diet. For cooking, washing, bathing, and manufacturing purposes the purest water is the best. Each one of these subjects might be made the topic of practical suggestions, but as my limits will not allow me to add more on the subject of pure water, I would say, in conclusion, that for all purposes for which water is employed by man, the purer it is the better it is adapted for his use.

It is understood that Mr. G. G. Scott will erect the new buildings that are required for the art department of Glasgow University. The site of the new works will be Gilmore Hill.

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* From the *Popular Science Review*.—Robert Hardwicke, Piccadilly.

† There are two classes of filters sold for public use, one of which is constructed of loose charcoal, and performs its duties admirably; whilst another class is made of charcoal more or less compressed and moulded, which prevents the due purification of the water.

GLEANINGS FROM SCIENTIFIC WORKS.

THE total weight of the oxygen of the atmosphere is estimated as equal to 134,000 cubes of copper one kilometre in the side.

THE fall of the Thames between Chertsey and Teddington lock, is nearly 17½in. in a mile. That of the Nile, from the foot of the first cataract to the sea, is 0.525 feet in a mile.

MOST of the gunboats built during the early part of the American civil war are stated to be quite rotten. The Ottawa is so far gone that the shipbuilders can do nothing with her.

IN London alone there were last year killed in the streets 233 persons, which is far in excess of the number killed on all the railways in the United Kingdom during the same period.

ON the night of the 4th inst., Dr. F. Tietjen, first assistant of the Berlin Observatory, discovered a new planet of very pale colour, belonging to the well-known group between Mars and Jupiter.

A STEAMER constructed after the system of Winan's "cigar" ship has just been launched at Havre. Its length is 73ft., and breadth 9ft. It is provided with eight screws, of which six are entirely submerged; these are worked by engines of 25-horse power.

THE cast-iron bridge at Coalbrookdale was erected in 1773, that at Sunderland between 1792 and 1795, and that at Southwark between 1809 and 1815. These are the oldest examples of the cast-iron arch in existence.

COPPER is fifty times a better conductor of electricity than bismuth, but its diamagnetic capacity is nearly nil. Antimony is less diamagnetic than bismuth, but it is a better conductor.

THE same absolute measure of heat exists at all heights in the atmosphere. Its apparent decrease proceeds wholly from that enlargement of capacity which the attenuated fluid acquires.

IN that part of the Andes which lies within the tropics, Humboldt found Fahrenheit's thermometer indicated a fall of 0 9 deg. for every 288ft. of perpendicular elevation.

The electricity of the air increases continually in proportion as the distance from the earth becomes greater; but at a certain height it becomes uniformly constant.

IT is said that a Captain Hagstrom, a Swede, has invented a new sort of needle-gun, which is to supplant the Prussian needle altogether. It fires ten shots in a minute, and does not get foul after a hundred shots. It has been accepted by the Swedish Government, and is to be introduced into the army.

LAMPS of an improved description are now being introduced into the streets of Paris. Candelabras, bronzed, are being erected at distances apart of a out twenty-six yards, instead of about forty, as formerly. The light also is brought nearer to the ground, and is thrown upon the pavement by a reflector.

Mr. BEVAN found that when two cylinders of dry ash, 1½in. in diameter, were glued together, and, after twenty-four hours, torn asunder, it required a force of 1,260 lb. for that purpose, and, consequently, that the force of adhesion was equal to 715 lb. per square inch of surface.

ATTENTION has been called to the quality of ash timber often used for oars of boats. A great many, perhaps nine out of ten, are made of brown American swamp ash, which is very brittle, and liable to break on any sudden jerk or strain. Oars ought always to be made of white Russian ash, which is very tough and durable, and not much more costly than American.

VINES require a mean annual temperature exceeding 49·50 degrees Fah. The mean winter temperature must not fall below 33 4 degrees Fah., and this must be followed by a mean summer heat of at least 64·4 degrees. The vine cannot be successfully cultivated when the temperature is beyond 71 degrees.

LIEBIG suggests that in close rooms and on shipboard deficient ventilation may be compensated for by the use of hydrate of lime. Eighteen or twenty pounds of slaked lime will absorb 38 or 39 cubic feet of carbonic acid gas, which would be immediately replaced by an equal volume of fresh air entering through the crevices.

MONS. COUPVENT states that the height of the waves in the Pacific Ocean diminishes in going westward; that in the Indian Ocean they are highest towards the middle of the expanse of waters: and that in the Atlantic the waves increase in height from east to west. He also states that the waves are highest off the coast of Australia between 50 deg. and 60 deg. of latitude.

M. PARROT has calculated the acceleration of the movement of the heart at 5 beats for the first 1,000 metres of elevation, 7 additional for the next 500 metres; 8 for the next 500; and five for every additional 500 metres; or, on an average, one pulsation for every 100 metres. Of the first thousand metres the heart's action is accelerated only one beat for every 200 metres of elevation.

Dr. VERDEIL, of Lausanne, stated that the celebrated dry fog of 1782 and 1783, "diffused at night a light which permitted objects to be seen at a certain distance, and which extended equally to all parts of the horizon." The light was similar to that of the full moon with a sky generally covered, or when concealed behind a thick but more partial cloud. The dry fog of 1831 also emitted phosporescent light.

HUMBOLDT has found the mean equatorial temperature at the level of the sea to be 81·5 deg. He has frequently found the thermometer indicate a temperature of 129 deg., when placed on the ground and on one occasion it marked upwards of 149 deg.; the thermometer in the sun at the same time only indicating a temperature of about 97 deg.

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AUTOMATIC TELEGRAPHY.*

By ALEXANDER BAIN, ESQ.

Automatic telegraphy consists of methods of transmitting and receiving previously-composed messages between distant places by means of self-acting machinery in connection with electric circuits, and, where properly carried out, it is distinguished from common telegraphy by the great celerity with which messages can be sent and received, as well as by the great accuracy it ensures in the transmission and reception of intelligence. Indeed, the advantages it offers have appeared to the writer of this paper so vast, that he has devoted to it much thought, time, and labour. He was induced to do so from the following reasons, viz., seeing that the action of the human hand, however expert, could never take a tithe of the advantage of the speed of electricity, and also that the use of numerous wires was very objectionable in consequence of the increased expense, but far more so from the great difficulty of obtaining good insulation among many wires of great lengths. At the time he first turned his attention to the subject of electric telegraphy several wires were used for each pair of instruments, and never less than three, in consequence of which he endeavoured to contrive methods for reducing the number of wires, and soon succeeded in producing instruments capable of working on a single circuit, and afterwards succeeded in working with a single wire, having discovered that the earth might be used with great advantage for one half of the telegraphic circuit. As this property of the earth is unquestionably a most extraordinary phenomenon, and still remains a paradox even to scientific men, and plays now a most important part in telegraphy throughout the world, and as the discovery has been independently made by others as well as the present writer, it will be well to give the ideas of scientific men respecting it, for instance, the writer on mathematical and physical science in the "Encyclopædia Britannica," eighth edition, vol. I., p. 986, observes, under the head of "The Earth Circuit," "There is one circumstance connected with the electric telegraph deserving of particular notice, I mean the apparently infinite conducting power of the earth when made to act as the vehicle of the return current. Setting all theory aside, it is an unquestionable fact that if a telegraphic communication be made, suppose from London to Brighton, by means of a wire going thither passing through a galvanometer, and then returning, the force of the current shown by the galvanometer at Brighton will be almost exactly doubled; if, instead of the return wire, we establish a good communication between the end of the conducting wire and the mass of the earth at Brighton, the whole resistance of the return wire is at once dispensed with. This fact was more than suspected by the ingenious M. Steinheil, in 1838, but, from some cause or other, it obtained little publicity; nor does the author appear to have exerted himself to remove the reasonable prejudice with which so singular a paradox was naturally received. A most ingenious artist, Mr. Bain, established for himself the principle, and proclaimed its application somewhat later, and, in 1843, perhaps the first convincing experiments were made by M. Matteucci, at Pisa."

Again, Lardner observes that "of all the miracles of science surely this is the most marvellous. A stream of electric fluid has its source in the cellars of the Central Electric Telegraph Office, Lothbury, London; it flows under the streets of the great metropolis, and, passing on wires suspended over a zigzag series of railways, reaches Edinburgh, where it dips into the earth, and diffuses itself upon the buried plate. From that it takes flight through the crust of the earth and finds its own way back to the cellars at Lothbury."

Instead of burying plates of metal, it would be sufficient to connect the wires at each end with the gas or water-pipes, which, being conductors, would equally convey the fluid to the earth; and, in this case, every telegraphic despatch which flies to Edinburgh, along the wires which border the railways, would fly back, rushing to the gas pipes which illuminate Edinburgh, from them through the crust of the earth to the gas-pipes which illuminate London, and from them home to the batteries in the cellars at Lothbury.

Although the automatic system has met with much opposition and neglect for a period of nearly twenty years, the writer thinks the time is fast approaching when the increasing requirements of the public will compel its general adoption; indeed, this necessity is partially shown by the number of telegraph inventors who have brought forward machines on the same principle during late years; but it is more clearly shown by the huge double ranges of numerous wires we already see stretched in all directions over the country, causing a vast (first) outlay; and a continual unnecessary expense to keep in order; but, setting the matter of cost aside, let us look at the working effect. It is well known that in damp and foggy weather, however well insulated the wires may be, small portions of the electric fluid will escape, from wire to wire, at all the points of suspension, and often from one to all on the same line of posts, especially between the longer and shorter wires, causing confusion among the instruments, and this confusion is greatly increased when many instruments are working at the same time.

Again, when storms arise, numerous wires, especially when near each other, present so large and compact a surface to the gale, that they are far more liable to be broken or blown down than one or two would have been, especially when snow or ice collects upon them. Should this take place to a considerable thickness, a heavy gale must exert an enormous force against them, so much so, that the posts or wires must give way (as has recently happened), very likely both. And when such a disaster takes place, what is the result? Why, it will take as many weeks as it would days were there only one or two wires to repair, causing an immense loss to the public, as well as to the companies themselves, leaving the great cost of repairs out of the question.

Yet notwithstanding these well known facts, these double ranges of many wires are stretched within a few inches of each other for hundreds of miles amidst the humid air of this country. Among numerous wires the fluid has thousands of chances of escaping from one to all, or any of the others. These chances are invariably seized, and hence deranged action of the instruments, causing mistakes, repetitions, general confusion, and consequent delay, and every additional wire put up only adds to the difficulty. In consequence of the foregoing reasons, the chief object of every telegraphic engineer should have been to contrive instruments of the greatest possible celerity, for the purpose of doing as much work as possible with a single wire. With a view to that end the writer turned his attention to the subject of automatic telegraphy at an early date, and in 1843 patented an automatic copying telegraph. Diagrams of these instruments are shown. They consist of two powerful pendulum clocks, and two smaller pieces of clockwork; these last are moved by weights, which consist of metal frames, in each of which is placed a plate, N, composed of conducting and non-conducting materials, in the following manner:—A frame is filled with short well insulated wires parallel to each other, and then filled in with sealing-wax, so that the whole forms a perfectly compact body; the two flat surfaces are then ground perfectly smooth, and are permanently fixed in the metal frame, at the back of the plate, in which may be placed either a composed form of printers' types or any other surface which may be desired to be copied at a distant station, and chemically prepared paper at the receiving station. Each of the pendulums carries a metallic arm, the points of which act as tracers on the surface. Now, let us suppose one frame filled with a previously composed form of printer's types, and the other frame with chemically prepared paper. The electric current will flow from the positive pole of the battery to the type, from thence through the small wire to the tracer, up the pendulum to the long telegraph wire, down the pendulum rod of the receiving instrument, through the tracer to the short wires, and from thence to the chemical paper, forming thereon a series of small dots, corresponding with the forms of the types at the transmitting station. The magnets to the left of the clock movements release the small clock-work so as to allow the frames to drop through a small space at every vibration of the pendulums; the pendulums regulate each other at each vibration to the left.

Having by the foregoing efforts gained much experience, although he had arrived at little satisfactory results in automatic telegraphy, he decided to compose the messages in some simple telegraphic characters by mechanical means, and after much labour, and the trial of many methods, he was fortunate enough to hit upon the plan of composing the messages by means of punching groups of perforations in paper, in such manner that each group represented a letter, numeral, or other sign, which has turned out to be a most simple and efficient plan. At first the punches were operated by hand, without the aid of machinery, and the working was consequently rather slow, but the writer having subsequently contrived machinery for the purpose, they can be now worked with great rapidity.

Of all the known effects produced by electricity, the chemical has been found by the writer best suited for automatic telegraphy, principally because it is quicker in its action than any other, having nothing of ponderability to move, and consequently no inertia to overcome.

Electro-magnetism, it is true, would answer to some extent, but in that case ponderable bodies had to be moved with great rapidity by the electro-magnetic force, and on long telegraphic lines the force being small, all the mechanical actions produced by it must be of necessity very delicate, and require fine and delicate adjustments, which have to be often varied with the varying strength of the currents. Besides, delicate mechanical actions are always liable to get out of order; so that, after much thought, and numerous experiments with the magnetic as well as the chemical effects of electricity, the writer decided to use the latter only for his automatic system, as the currents would have nothing to perform but decomposition at the point of the chemical pen, the machinery being worked by other power.

In order to show how the chemical property of the current may be made to produce visible marks or signs, let us suppose a sheet of paper, wetted with an acidulated solution of ferro-prussiate of potash, and laid upon a plate of metal, and let the point of a steel, or copper style, be applied to it so as to press it gently against the metallic plate. Let the style be now put in metallic connection with the wire which leads to the positive pole of a voltaic battery, and let the metallic plate upon which the paper is laid be put in connection with the wire which leads to the negative pole. The current will, therefore, flow from the style through the moistened paper to the metallic plate, and it will make a blue or brown spot thereon according as the style is of iron or copper.

If the paper be moved under the style while the current flows, a continuous line will be traced upon the paper. If while the paper is thus moved the current is permitted to flow only during intervals of long or short duration, the paper will be marked with lines long or short, according to the intervals during which the current flows; there being no mark made during the suspension of the current. The long or short lines thus traced upon the paper will be separated one from another by spaces more or less wide, according to the lengths of the intervals of suspension of the current. It is evident that the same effects will be produced, whether the style be at rest and the paper moved under it, or the paper be at rest and the style moved over it. The paper may be moved under the style by various mechanical expedients. It may be in the form of a ribbon coiled upon a roller, and drawn under the style, which was one of the writer's first plans, or it may be in the form of a common square sheet and wound upon a cylinder, to which could be given a revolving motion, and at the same time receive a slow motion in the direction of its axis, so that the course of the style upon it would

* Read before the Society of Arts on the 17th of Jan., 1866.

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FIG. 5.

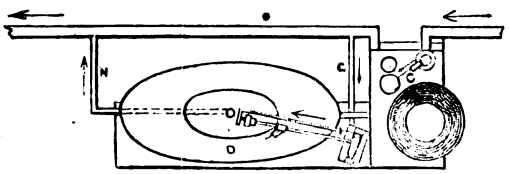


FIG. 6.

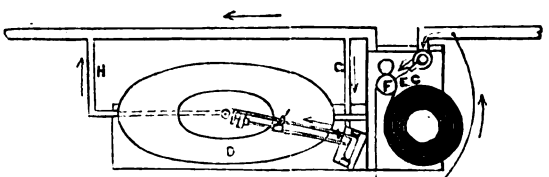


FIG. 3.

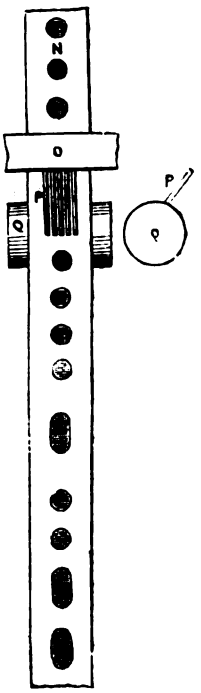


FIG. 1.

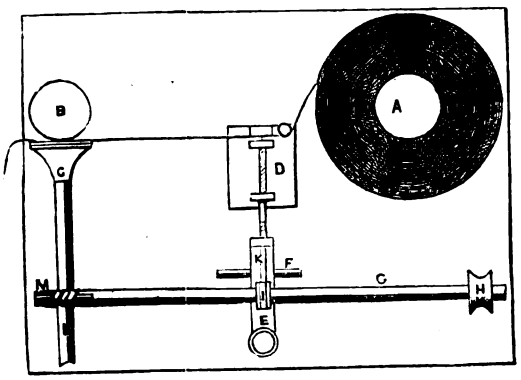


FIG. 4.

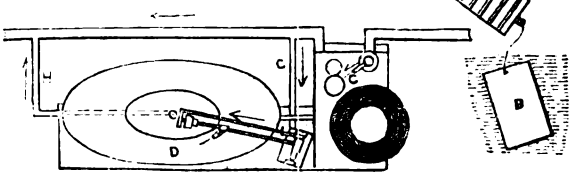
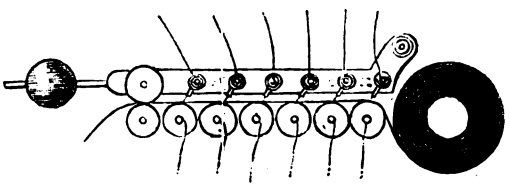


FIG. 7.



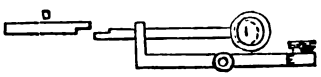


FIG. 2. ELEVATION

be that of the thread of a screw or helix; this was also one of the plans the writer adopted in his early experiments, but the plan he has found most convenient in practice is to cut the paper into the form of circular discs, of about 18 or 20 inches diameter, and after being chemically prepared, any required number are laid upon a metallic disc of equal size. To this disc is given a motion of revolution round its centre, in its own plane, by clockwork, or any other convenient power, while the style receives a slow motion directed from the centre of the disc towards its edge. In this case the style traces a spiral curve upon the paper, winding round it continually, and at the same time retiring constantly but slowly from its centre towards its edge.

PUNCHING MACHINE.

Fig. 1 represents a plan of so much of the punching machine as will explain the principle of its action. A is a roll of ribbon paper; B and C are two revolving discs for the purpose of drawing forward the paper from off the reel; D represents the punch; E a finger key, with its axis at F; H is a pulley which receives rapid motion from a wheel driven by the foot, similar to that of a sewing machine; I is an eccentric on the shaft G, which gives rapid to-and-fro motion to the rod K, on the rod G; at L there is a screw which works into, and gives motion to, a wheel M, which is on the shaft of the disc C. It will be observed that when the pulley H receives motion from the band, the eccentric I gives rapid to-and-fro motion to K, at the same time the screw at L gives a slower motion to the wheel M and the discs C and B, which draw forward the paper in front of punch D. Now, if the finger key is pressed down at E, (shown in elevation by Fig. 2.) the other end of the key will raise the rod opposite the punch, which will be pressed forward rapidly and punch the paper. If the key is pressed but for an instant a short hole will be punched, but if kept down for a longer interval a longer hole will be punched. In this way groups of short and long holes can be punched at pleasure representing letters, words, and sentences, and thus messages can be composed of any length and with considerable celerity. These messages can then be carefully compared with the manuscripts from which they were taken and, if needful, corrected before being placed in the transmitting machine, so that no mistake should ever be sent along the line.

TRANSMITTING APPARATUS.

Fig. 3 is an enlarged view of so much of the transmitting apparatus as will explain the principle of its action. N is a portion of paper ribbon with groups of perforations, each group being supposed to represent a letter of the alphabet; O is a metal bar in which are fixed five metal springs in the form of the teeth of a comb; Q is a metal roller insulated from O, except at the points of the springs P. Now let O and Q be in the telegraph circuit, and the paper drawn through, as it may be, with great rapidity, when the perforated portions of the paper pass under the springs they come into contact with the roller Q, and the current flows through the circuit, and when the unperforated portions of the paper are under the springs the current is interrupted thereby. In this way electric currents can be sent through telegraph circuits with extraordinary rapidity and perfect accuracy in their duration and grouping.

RECEIVING APPARATUS.

The receiving portion of the apparatus is a revolving disc carrying chemically prepared paper, and a metal frame carrying a revolving screwed shaft; on the upper end of this shaft is fixed a roller, which lies gently on the disc. The screwed shaft carries a style-holder. As the disc revolves it gives motion of rotation to the roller, and consequently to the screwed shaft, which causes the style-holder to recede slowly but constantly from the centre towards the outer edge of the disc. Now let us suppose the apparatus properly arranged in the telegraph circuit, as is well known, the currents from the comb and roller at Fig. 3 will pass through the style into the chemically prepared paper at the receiving station, and make marks thereon corresponding exactly in their lengths and their grouping with the perforations in the paper shown at Fig. 3.

Having thus described the principal actions of the composing machines, and also of the transmitting and receiving apparatus, let us now proceed to show how they are combined so as to form a complete system.

The author proposes to have only two wires at most on one line of posts, one to be called the up wire, and the other the down wire, so that messages can be transmitted in both directions at the same time. The messages are transmitted by the apparatus through the main wire in the manner shown at Fig. 3, but his experience has shown him that the best way to receive the messages is through branch circuits, so as to keep the main wire contacts always complete, except in the process of transmission.

Figs. 4, 5, and 6, represent three different stations on a telegraph line. A represents a galvanic battery, C the transmitting apparatus, and D the receiving portions at each of the stations; the transmitting and receiving apparatus, it will be observed, are moved by the clock mechanism at C, the instrument (Fig. 6) is shown in the act of transmitting. Figs. 4 and 5 are shown in the position of receiving. Although only three instruments are shown, there may be any desired number on the same line.

The action is as follows:—The current passes from the battery A to the main wire, from thence to the spring E, through the perforations of the paper to the roller F, then to the frame of the clock-work, and from thence to the main wire, but at each of the intermediate stations, when they are necessary, a portion will pass down through the ends of the branch circuits at G, to the frames I, through the styles to the chemical paper, and will return by the end H to the main wire. In this way the currents are made to write a copy at every station on the line, but at the stations where copies may not be desired, all that the operator has to do is to lift up the pen from the paper, and let it stand in the position shown at Fig. 6, or he may turn back the penholder frame altogether away from the disc.

Fig. 7 shows a method by which a despatch can be transmitted from a central station, say from London, to any number of telegraph lines simultaneously, so that the despatch may be received and written at any number of towns on each line, in the way already described.

This system has been proved electrically, chemically, and mechanically in England, France, and America. It can transmit intelligence from London to the farthest corner of England or Scotland at the rate of, in round numbers, six words per second, 333 per minute, 20,000 per hour, and with a degree of accuracy never before obtained by any other system, and, further, it can automatically transmit despatches of any length from any place, say from London, to all the principal towns of England simultaneously at the above-named degree of celerity.

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THE LATHE AND ITS USES.*

IV.

To suit different kinds of work, as previously stated, various tools are needed, but the reader must not expect to see them all illustrated in these articles. It would take much more space than we could spare; besides, the workman will see, as he learns what tools he needs, and makes them for himself, which will be of more advantage to him than engravings could be. The tools here shown will be found very useful in different places.

Fig. 8 is the end of a thin-edged, flat scraper, and is chiefly to be used on brass work. It may be of any length and size, but for small lathes, and light work, it is cheaper and handier to make it of thin sheet steel, one-eighth or one-tenth of an inch thick, and to form the reverse end into a round nose, or half circle scraper.

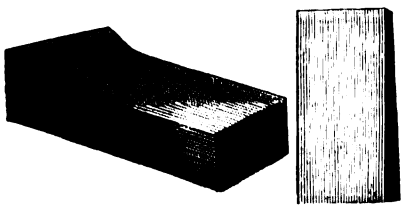

Fig. 9. Fig. 8.

It often happens that fillets or hollows occur, as in finishing ornamental brass work, in connection with flat surfaces. By having such a tool as this the necessity of laying one tool down and picking up another is obviated, for the two are combined in one. For iron work it is customary to use a heavier and thicker tool for finishing. As in Fig. 9, the front edge is slightly raised or concave, to make it sharp and hold a cut well. All turning tools for finishing iron are made thicker than those for brass, and should have lips or curved cutting edges. Such tools cannot be used for brass, as they are too sharp; the edges jump into the metal and spoil the work.

A tool for scraping brass work of some kinds is made as shown in Figs. 10 and 11.

Fig. 10.

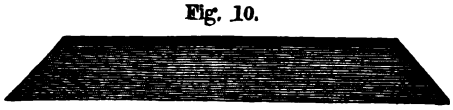

Fig. 11.

There is no occasion to make the ends at different angles, except the convenience before stated of having four cutting edges on one piece for any angle can be easily given by the position of the hand or the direction of the rest. These tools here alluded to are only to be used when the job has been all turned true and the scale removed; they *scrape*, merely, they do not cut.

Such tools sometimes save a few steps at a critical period; that is, when the tool is well and in place, so that the work is done better and more expeditiously. Apart from this considerretion, there is the chance of cutting or injuring tha hands by the proximity of sharp edges. Unlder the control of an expert, however, there is li e danger from his cause, as inspection will show. Skilful men, that have worked a lifetime at heir trade, have few marks or scarse on their hands, as a general thing.

When these scrap rs are used on cast iron, or indeed, on brass of a peculiar composition they, sometimes "chatter," as it is called, and leave the work full of deep, unsightly marks, like those on the edge of coins. The cause of chatteringh is the pid vibration of the tool, so that it springs away from and against the work with great rapidity, leaving traces of its edge on the work. Chattering may be prevented by putting a piece of sole leather on the rest, between it and the tool.

The tools with long handles are chiefly intended for heavy work, or that which requires both hands to the cut, but there are smaller tools than these used by amateurs, wherein the common file handle, or one like it, only a little longer, is employed instead.

CHASING AND SCREW CUTTING.

In a engine, or power lathe, all screws are cut by trains of gears, as mechanics well know, but in the hand lathe, which was the first machine, screws, both male and female, must be made by chasers or hubs, both inside and outside. The chaser itself must be made first, however, and that is done by a simple tool called "a hub."

Fig. 12

The chaser is first forged in blank, for an outside chaser, as in Fig. 13, and as in Fig. 14 for an

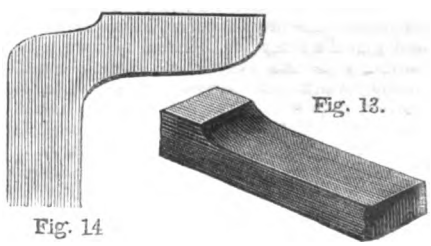

Fig. 13.

Fig. 14

inside tool. It is then filed up and held against a hub, shown in Fig. 12, running in the lathe. This rapidly cuts away the chaser blank and forms the teeth in it perfectly. The lines across it are spiral grooves, cut completely round from one side to the other, so that the hub cuts the blank like any other tool.

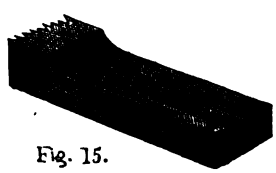

Fig. 15.

This is the chaser, Fig. 15.

* Mostly compiled from *American Journals*

ROTARY STEAM HAMMER.*

A very ingenious application of the long known rotatory steam engine has lately been introduced by Mr. James Munro, of Holytown, near Glasgow. Fig. 1 of the engravings is a side elevation of the hammer; Fig. 2 a plan; and Figs. 3 and 4 are longitudinal and transverse sections of the cylinder, showing the arrangement of the piston and valves by which the steam is admitted and exhausted. In Figs. 1, 2, 3, and 4, the part marked A is the cylinder, in the interior of which the rotatory piston, B, Figs. 3 and 4, partially revolves, the steam being admitted through the pipe, C, Fg. 2, and exhausting at D. A peculiarity in this hammer consists in the mode of arranging the admission and exhaust of the steam; this is effected as follows:—After the steam has been admitted through the pipe, C, it passes thence through the opening, *a*, into that side of the piston which has to be either raised or depressed, as the case may be; in Fig. 3 the valve and opening, *a*, are shown in position to raise the hammer after the completion of the downward stroke. Whilst the opening, *a*, of the valve is admitting steam to one side of the piston, the steam from the other side exhausts through one of the ports, *b* or *c*, into the annular chamber, *e*, whence it passes directly into the exhaust pipe, D. On referring to Fig. 1 it will be

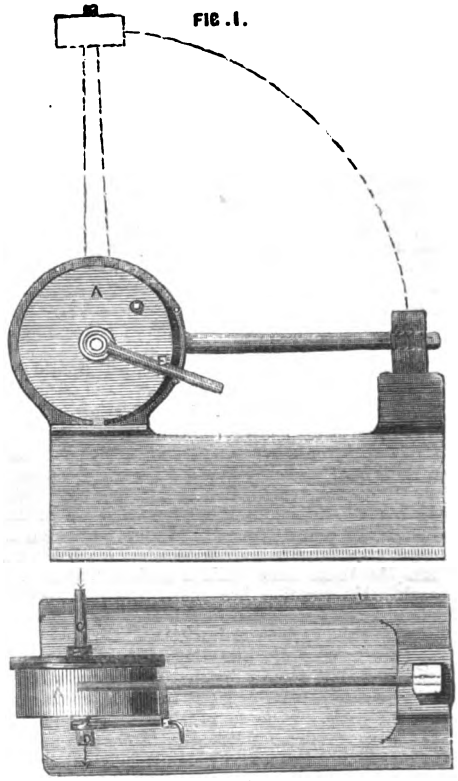

FIG. 1.

FIG. 2.

seen that the limits of the movement of the hamme are between an angle of 90° and no motion at al—thus a large range of percussive action is obtained, the force of the blow of course varying with the distance and velocity through which the hammer falls. In starting the hammer it is merely necessary to raise the lever, E, by which the steam is admitted between the fixed ram and one side of the piston, B; the upward movement of the hammer shaft, catches, by means of the stops on the lever, E, at suitable points in the upward and downward stroke, and thus the requisite lead for the admis-

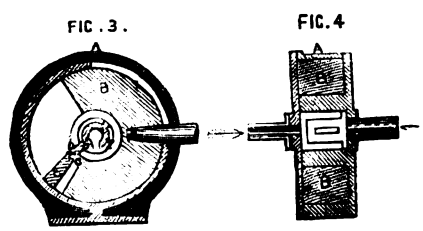

FIG. 3. FIG. 4

sion is secured. We need scarcely add that the adaptation of this hammer, to which we have but so briefly alluded, is likely to a considerable extent to supersede the blacksmith's universal companion, his striker, or hammerman—we mention this as he first impression on our own mind as to its varied powers of adaptation. It is not yet arraniged to strike a side or oblique blow, but even this may be done.

* Extracted from the *Practical Mechanic's Journal.*—Longmans and Co., Paternoster Row

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REVIEWS.

Contributions towards a History of Electro-Metallurgy, &c. By HENRY DIRCKS. E. and F. N. Spon, Bucklersbury, London.

In our great battle of life, in which we are all fighting, ever fighting, some for mere food and shelter, some for honour, some for wealth, some for power, some for this thing, some for that, it has often struck us that we have no combatants more perseveringly pugnacious, more possessed by the good, if obstinate, old Saxon spirit of standing-by-your-rights, than the class called inventors or discoverers are. The untiring energy, the unconquerable bravery of this well-deserving and seldom fairly rewarded class—to whose such natural characteristics our discoveries and inventions are mainly due—may, perhaps, have originated this fact, for that it is a fact no one acquainted with the histories of such men will deny. He is no tame or spiritless being who seizes first upon some ideal suggestion, and, pursuing it laboriously to the far away end, accepts difficulties, dangers, and failures as mere matters of course, even when they are unexpectedly encountered on the very eve of foreseen success. It is not to be expected that such a man will very readily, or, at least, without some display of bitterness, relinquish that for which he has toiled long and hard, and which he therefore (rightly or wrongly) conceives to be justly and purely his own.

The above remarks find their illustration in the little work before us, which records and compares the rival claims of Mr. Thomas Spencer and Mr. C. J. Jordan in connection with the question, "Who invented the process called electro-metallurgy?" Like other similar questions, such as, "Who invented the steam engine? Who discovered the composition of water? Who first found the planet Venus? Who invented photography? Who invented painting in oil?" &c., &c.—for there have been a countless number of such—this question has been the battle-cry of many a hotly contested field. In these fights the noises of the various claimants and their partisans or friends may die away into silence every now and then, but some stray shot or some new leader will be sure, sooner or later, to revive the controversial strife. It is so in this case. The book before us was first published in 1863, and appears to decide the dispute to which it is devoted; and yet it was but the other day that we read in the *Times* letters reopening the old quarrel, beginning it all over again with the same obstinate never-know-when-you-are beaten spirit, as before.

The invention of electro-metallurgy has been long and popularly ascribed to Mr. T. Spencer. You can take up few works on the subject in which this is not stated as a well-known indisputable fact. And yet it was hardly less well known as *a published fact* that Mr. C. J. Jordan had the claim to priority of publication in this matter, or that Messrs. Elkington, Mason, and Co., the proprietors of the vast electro-plate works at Birmingham, in which upwards of 500 people are employed, held patent rights never granted them by the supposed inventor, and yet dating from 1836, more than two years before either Mr. Spencer or Mr. Jordan published a line on the subject. This mystery is now solved by a letter which appeared in the *Times*, claiming for the late Mr. J. Wright, surgeon, of Birmingham, the honour of being inventor of that process (see page 212, *ante*), by which it seems that Mr. Wright made an arrangement with the Messrs. Elkington for the patent taken out in December, 1837. Mr. W. Wright, the author of this letter, adds—"I never heard of a Mr. Spencer or anyone else disputing the patent with Mr. Elkington, or yet claiming any Royalty." How it comes to pass that Mr. Wright, residing within a few doors of Mr. Dircks' publisher, never before heard "a" Mr. Spencer's name mentioned as the inventor of electro-metallurgy; or, having heard it, never took the trouble to combat his claim, does seem funny.

We never before heard of "a" Mr. Wright as he inventor of this process, and it is evident that Mr. Dircks, one of our best known civil engineers, and one of the earliest workers in electro-metallurgy, is in the same position. In the pages before us we find the rival claims of Mr. Jordan, Mr. Spencer, and others, duly set forth and compared. Facts and dates, with all the published, and much previously unpublished evidence, are placed before us. We read of the great and the small warriors who have fought in the cause, the names of the fields whereon the fights were fought, the list of the wounded, slain, and defeated, and thus have fought the battle "o'er again." But, although earnestly desirous of putting the right man into the right place, Mr. Dircks has evidently no idea of his being Mr. Wright. All our author's efforts are rendered to place the victor's crown on Mr. Jordan's head.

It may interest many of our readers to give a brief account of the contending claims made by the rival inventors Mr. Dircks deals with.

Mr. Spencer published his process in a paper read in September, 1839, before the Liverpool Polytechnic Society, in the course of which he asserted that his experiments dated from 1837. This paper, however, was announced on the 8th of the previous May.

Mr. Jordan published his first descriptive announcement in the pages of the *Athenæum* in a letter dated the 22nd of May, 1839, stating that his experiments were commenced in 1838.*

Mr. Spencer promised his paper in writing on the 8th of May, and briefly described its subject; his promise was, we presume, published, and, according to request, duly recorded at that time. It is, therefore, on this fact that his claim must be based to rank as the inventor of electro-metallurgy, to do away with which Mr. Dircks advances evidence intended to show that Mr. Spencer adopted the experiments and results of Mr. Jordan, as published some months before his paper was read, and that the letter Mr. Spencer first wrote to the Secretary of the Polytechnic Society contained nothing which could be accepted as evidence of his having, up to the 8th of May, actually made the discovery which Mr. Jordan clearly and fairly described on the 22nd of the same month.

It will at once be seen that evidence calculated to decide these nice points must necessarily be of a somewhat delicate nature. Looking to priority of publication, which is the kind of evidence usually and wisely accepted in these matters, we find that Mr. Spencer first announced that he had invented this process, and that Mr. Jordan first published the process itself—the former gentleman, in a letter to the secretary of a society, to which its receipt was of course announced, and the latter, in the more tangible and unquestionable form of a letter to a public journal, in which it was given to the world at large.

So stands the matter. Let those who will decide. Mr. Dircks does so very emphatically. Allowing Mr. Spencer high merit as an improver, he denies that he has the slightest claim to rank as an inventor, and certainly advances evidence possessing no mean force in support of his statements.

It is not always the inventor who gains either the honours or advantages of his inventions, and we see no reason why we should indulge in the common custom of giving both the honour and the more solid advantages to one man, simply because he is the patentee, who may have merely reaped where others have sown. We agree heartily with the old writer who said, "Where inventions creep by degrees it must not be thought strange if it be not easier to say who is the first inventor." And if any invention is due to creeping by degrees, it is certainly that of electro-metallurgy, which we have the clearest evidence to show—to quote the aforesaid sensible old author again, was not "made at once (by the same man at the same time) but successively; by the joint advice of diverse inquisitive men, and in a considerable tract of time?"

"Inquisitive" Brungnatelli, in a letter to Van Mons, written in 1805, and which has been preserved and several times published*, says he "had gilt in a complete manner two large silver medals by bringing them, by means of a steel prize, into communication with the negative pole of a Voltaic pile, and keeping them one after the other immersed in ammoniuret of gold newly made and well saturated." In the same year Grothus wrote on the decomposition of solutions. In 1806 we had Sir Humphrey Davy's experiments in this direction. In short, a glance over the proceedings of the Royal Society in any of the published reports, or in the "Philosophical Transactions," will amply demonstrate how electrical science did "creep by degrees" towards this new application.

In the "London and Edinburgh Philosophical Magazine" for 1863 will be found an article "On the Effects of a Battery charged with Sulphate of Copper," by Mr. Warren de la Rue, in which that very "inquisitive" gentleman says: "The zinc plate is always partially covered with a coating of copper, which, however, is not detrimental to the power of the battery; the copper plate is also covered with a coating of metallic copper, which is continually being deposited; and so perfect is the sheet of copper thus formed, that on being stripped off it has the polish, and even the counterpart of every scratch of the plate on which it is deposited." Dr. Golding Bird, lecturer on Experimental Philosophy at Guy's Hospital, read, on the 2nd of February, 1837, in a sectional meeting of the British Association, a paper "On the Electro-chemical influence of long continued electric currents of low tension." This paper, read before the Royal Society in the same months, may be found in the "Philosophical Transactions." Mr. Dircks informs us that Professor Farraday was present at the Liverpool meeting, and that he was "deeply impressed" by Dr. Bird's statements. The simple galvanic arrangement introduced and described by Dr. Bird as invented by himself, in the opinion of Mr. Dircks and "in the hands of Mr. Jordan and other experimenters, originated the beautiful process of Electro-metallurgy."

But we must pause. To continue our list of the many inventions, suggestions, and discoveries by which electricity advanced to the end in question would claim far more space than we should be justified in devoting thereto. The names of Daniell, Bessemer, Jacobi, Woolrich, and many others, will probably suggest themselves to our readers, and they will doubtless agree with us in saying, as does the old writer our Magnetism above quoted—"It must not be thought strange if it be not easier to say who is the first inventor." Such facts "point a moral" which we commend heartily to those concerned.

Mathematical Drawing Instruments.—We notice that Mr. W. Stanley, of 5, Great Turnstile, Holborn, is about to publish an illustrated work on the uses, qualities, and selection of mathematical drawing instruments, with suggestions for improvements, and hints upon drawing, coloring, and drawing material. The price will be five shillings. A cheap work like this has been long wanted.

A MEMOIR, by Professor Nicklés, of Nancy, on the effects of colouring and the extinction of colours by artificial light, was received at a recent meeting of the Academy of Sciences at Paris. M. Nicklés gives an explanation of the fact that colours seen by night are not the same as when seen by day, and states that the magnesium light restores to colours their normal tints.

On the Continent, where many engineers are free to make Bessemer plant, it is understood that the furnaces, converters, blowing engines, and 5 ton hammer for two3-ton converters, can be made and set up for a much less sum than in England, where the first cost of such plant is not far from £10,000. In Austria there are literally mountains of spathic iron — each mountain being practically a crystal of ore.

* It will, therefore, be seen that as Mr. Wright's discovery was patented in 1837, neither the Spencer claim, the Jordan claim, nor most of the others advanced from time to time, could claim to be the right claim, which is, after all, the Wright claim.

* See page 3 of Napier's Electro-Metallurgy.

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LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

PHOTOGRAPHY.—STRAY HINTS FROM AN OLD BOOK.

Sir,—I have just tumbled over a stray hint or two in an old pamphlet on the daguerreotype process which I transcribe. If worth inserting, some of your readers may be glad to have them :—

1. "Persons with a freckly skin often complain of 'the black spots all over the face.' These can be hid by their rubbing their face so as to make it quite red. The red and yellow possessing about equal photogenic powers, will produce an impression with quite a clear character."

2. "When a group is taken and some of the party feel so 'funny' as to be unable to keep still, put the plate *holder* (without a plate) into the camera box as if you were going to take an impression, and let the party sit until they get sober. The operator has the same right to trifle with the *setter's* time (so in the original), as they have to trifle with his."

3. "Take a large woollen blanket with a long nap (the longer and rougher it is, the finer will be the effect produced), stretch it on a frame and suspend the frame at the centre of the upper end by a string fastened to a nail in the ceiling from three to five feet behind the sitter. Having arranged this, fasten another string to the side of the frame, and while the operation is going on in the camera, swing the background from right to left, and you will have a clear *transparent* background, which throws the image out in bold relief. If equalled at all, it is only by atmospheric background."

4. "So great is the difference in many faces when inspected in opposite directions, that one of the two views, however accurately taken, would not communicate the likeness, it not being the usually observed characteristic form. When the right view of the head is obtained, it is first necessary to consider the size of the plate it is to be taken on, so as to form an idea of the proportion the head should bear to it."

5. "In regard to the proper elevation of the camera, we would here state that we have found it best in taking portraits where the hands are introduced to place the camera at about equal height with the eyes of the sitter, in order to bring the face and hands equidistant from the tube (lens). It will be found if the above be followed, that by attaching a string to the camera tube, and making a semicircle, the face and hands of the sitter will occupy a corresponding distance." PICKER AND STEALER.

CARBONIC OXIDE *v.* CARBONIC ACID.

Sir,—In No. 41 of your journal, page 178, Mr. Tonkes makes the very startling statement that "carbonic oxide is the deadly gas which kills people who descend into wells, and is better known as the 'fire-damp,'" &c., and that "the sins of this deadly gas were for many years heaped upon the head of carbonic acid, one of the most innocent of the gaseous family;" going on to state that to carbonic acid we are indebted for "light bread, sparkling ale, and effervescing lemonade," and adding "we are much indebted to science for removing from the shoulders of this innocuous, jolly, good natured gas, the foul anathemas due to his younger brother" (carbonic oxide).

Now Dr. Black was acquainted with the properties of carbonic acid as early as 1755, and most of the properties of carbonic oxide were developed between 1801 and 1807, and since the latter date the distinguishing characteristics of the two gases have been well known. How, then, the properties of one could be attributed to the other for "many years," I am at a loss to imagine. Contrast the chemical physiognomy of the two as given below :—

Carbonic Oxide, (C. O.)	Is lighter than air as 967 is to 1,000. Has never been liquified or solidified. Burns with a lambent blue flame. Is not developed in any process of nature. Void of taste. No action on Litmus. Is scarcely absorbable by water.
Carbonic Acid, (C. O.2)	Is heavier than air as 1,529 is to 1,000. Has been both liquified and solidified. Will neither burn nor support combustion. Takes part in natural phenomena. Acid taste. Reddens Litmus. Is absorbed by water.

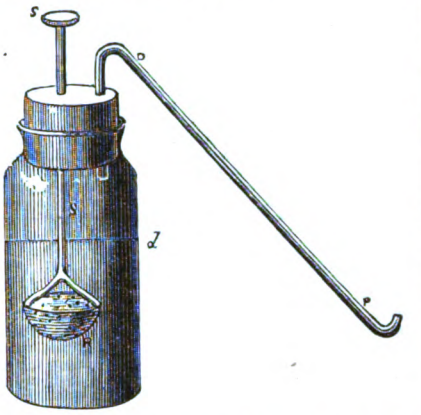
Mr. Tonkes, after telling his readers that carbonic acid may be prepared by decomposing chalk or marble with hydrochlorine (Hydrochloric he means), details the experiment of extinguishing a lighted taper with it, forgetting that the existence of life and flame depend upon the same conditions, and that an atmosphere in which a candle will not burn has been proved to be fatal to animal life, times without number.

Oxogen is life to the blood when introduced *via* the lungs, but it would not prove itself "innocuous" were the stomach inflated with it, and so by parity of reason, carbonic acid may be wholesome taken into the system *via* the stomach (under certain conditions), but breathed into the lungs it is a deadly poison.

But Mr. Tonkes makes his statements so uncompromisingly, that I presume he has authority and reason on his side. Will he, for the benefit of the truth, kindly quote the one or give proof of the other, and forgive my criticism if it be unjust?

I enclose for Mr. Tonkes and your chemical readers generally, a drawing of a gas generator, which I think they will find useful.

This little apparatus expedites manipulation and obviates the annoyance the operator has to contend with when experimenting with deleterious gases. It consists of a wide-mouthed bottle filled with a cork, through which the ordinary delivery pipe, D, P, is inserted. R, the receptacle for the substance to be decomposed, is furnished with a rod S, S, sliding air-tight through the cork, and by means of this rod it may be elevated or depressed—the bottle is filled with acid up to A, and the perforations in R allow the acid to drain off when it is drawn up.



Suppose the apparatus is to be employed for the production of carbonic acid, the bottle is filled up to A with fragments of white marble; it is then ready for work; and the requisite supply of gas may be commanded at pleasure by the operator simply depressing the stop, S, when he wants gas, and drawing it up when he wishes the supply to cease.

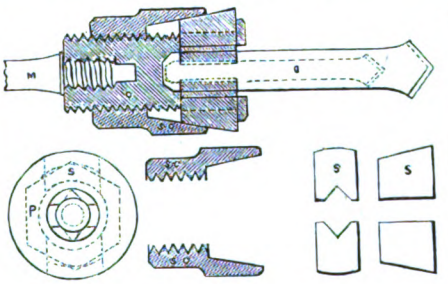
This apparatus is no less efficient than it is simple :—Slightly modified, it may be used either for the production of carbonic acid, sulphuretted, arseniretted, antimoniuretted, or pure hydrogen gases. For affording a constant supply of sulphuretted hydrogen it is as efficient as Kipp's elaborate apparatus, and may be made for one-twentieth the cost. It also removes the danger and inconvenience at present attendant upon Marsh's process for the detection of arsenic. J. BACON.

CHUCK FOR HOLDING WIRES.

Sir,—In your No. 43, is given a description of a drill chuck and boring collar, by T. E. Merritt. I find it will not act as stated. It is said to be applicable to any sized drill shank, : for instance: B, B, are the hinged jaws with conical ends, screwed nut D, to tighten same; granted. Suppose the chuck to be made for ½ inch drill; expand the jaws and put in a ¾ inch. The nut D will not fit, owing to the thread choaking upon the jaws.

Enclosed, I send you a rough drawing of a chuck which I made for holding wires, but which is equally applicable for drills, boring bits, &c. :—

C, C, chuck with S, C, loose collar screwed to traverse backward or forward; S, S, steel grips to hold drill or bit.



The main feature of this tool is that it can be adapted to hold various sized drills or bits. It is easily seen that by screwing up the loose collar S, C, which is conical, to suit the conical steel grips, the grips will be depressed upon the drill, and so hold it quite firm and central. P is a plan shewing the hexagonal part of loose collar for the purpose of screwing up; D, drill in position. H. GRAY.

OUR SUBSCRIBERS' NOTES AND QUERIES.

BASTARD WHEEL.—Can any of your readers give me the meaning of a "Bastard Wheel?"—J. A.

KNITTING MACHINES.—Will any correspondent inform me who is the maker of the Knitting machine, or where such machine may be purchased?—J. W., PRESTON.

BOILER FOR VELOCIPEDE.—Can any reader inform me what size Boiler, and Cylinders, would be required to drive a vehicle (after the fashion of the velocipede), the weight when complete would be about 4 cwt?—BRUCE WELCH

SAFETY VALVE BALANCE.—I see in your journal, No. 44, Mr. Wm. Carmerer's Safety-valve balance for locomotives, but I think there is another part of this instrument which is connected by the levers. I should be very glad if any reader could oblige me with a plan of the balance which is used on our principal railroads, which I think is different to Mr. Carmerer's.—W. LONGTON.

MOULD BOARD.—Can any reader inform me how to make a mould board for a plough, and the method of twisting it?—J. JOHNSTON.

WAX.—Can any reader inform me of a cheap book treating of wax, its manufacturers and uses?—M. G.

CYLINDERS OF MODEL LOCOMOTIVE.—Will any reader give me information on the following matter? I have a pair of cylinders, 1 5-8 inch stroke for model locomotive; also crank axle, eccentrics, &c. Now I am anxious to know the proper proportion of the locomotive to which they could be adapted, as regards its size of boiler, dimensions of frame, width between wheels, &c. It is to have six wheels. I should like the "drivers" to be as large as possible in proportion to engine.—W. E. J.

POLISHING IRON.—Can any subscriber inform me of the best method of boiling bright iron white with tin, either direct, or coppered first, and the best way of getting the metallic zinc back from the battery jars?—A. B.

PLASTER OF PARIS.—Will some kind reader furnish me with the proper method of obtaining a cast of the human face, also the method of finishing off nicely?—J. S.

GETTING UP BRASS WORK.—A Young Friend would be glad if he could be informed of the best method of getting up brass work after being fine filed, such as a Telescope Stand, &c.

ALUMINIUM AS A CONDUCTOR.—Can any reader tell me the Electrical conducting power of Aluminium, compared with Copper, that of Copper being expressed by 100, and their authority for it? I want to plate two Copper points of contact with a good conducting metal, Platinum being too expensive for the purpose.—J. C. S.

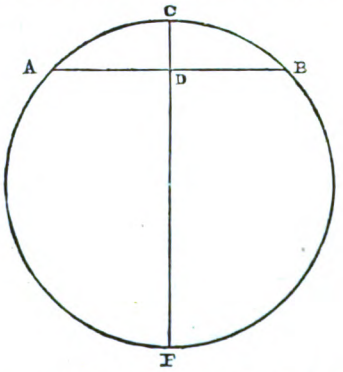
MODEL STEAM BOAT.—I saw in the "Notes and Queries" in the ENGLISH MECHANIC a drawing of a boiler for a Model Steam Boat. The correspondent who furnished the drawing forgot to state whether the circles are tubes or firebars. With regard to firing through the top, I think he might easily fire at the proper place by having part of the deck made so that he could remove it when he wanted to put more fuel on. I want also to know whether the boat would run for 3 or 4 hundred yards without firing?—P. G. HOULGRAVE.

FOOT LATHE.—I have a common foot lathe, the size of which is 6 inch centre; length of sides, 5 ft. × 2½ × 5-8. I wish to convert it into a slide lathe. Will any fellow-subscriber assist me to do this by giving me strength of screws, threads, &c., per inch; and also, say where I can get a cheap set of change wheels?—JOSEPH SHINGER

ELECTRO GILDING.—Can any reader tell me how to give to electro gilt articles the deep colour now generally adopted for jewellery. Does the quality of the gold used affect that of the plated article; or is the rich colour obtained by a separate process?—AN AMATEUR.

REPLIES TO QUERIES.

DIAMETER OF CIRCLE.—BUNSEN'S BATTERY.—In reply to H. T., the only method of obtaining the diameter of a circle (by figures) when the chord and versed sine are given is deduced from Euclid 3·35. Templeton gives the following rule in words to find the radius:—"To the square of half the chord (A B) add the square of the versed sine (C D), this sum divided by twice the versed sine (C D), gives the radius, which is of course half the diameter."



This rule is thus obtained algebraically. If we put r = radius, then by Euclid 3·35, we have—

$$\frac{A\,D^2}{C\,D} + C\,D = 2\,r$$

$$\therefore r = \frac{A\,D^2 + C\,D^2}{2\,C\,D} \text{ as above given.}$$

There is another form of this question which occasionally puzzles young mechanics, so that while I am on the subject I may as well refer to it. It is when the chord and diameter are given to find the versed sine (C D). If, in the same figure we put $C\,D = x$, $\frac{A\,B}{2} = a$, $C\,F = b$, then

$D\,F = b - x$, consequently—

$$x\,(b - x) = a^2 \text{ or}$$

$$x^2 - b\,x = -\,a^2$$

$$x^2 - b\,x + \frac{b^2}{4} = \frac{b^2 - 4\,a^2}{4}$$

$$\text{or} \quad x = \frac{b + (b^2 - 4\,a^2)^{\frac{1}{2}}}{2} \text{ or given in words,}$$

"From the square of the diameter subtract four times the square of half the chord, the square root of the remainder subtracted from the diameter, half the result gives the versed sine required, or using the plus sign the inversed sine is obtained." I would strongly recommend Carbon, even if he should get the particulars I am unable to furnish him with, not to go to the expense and

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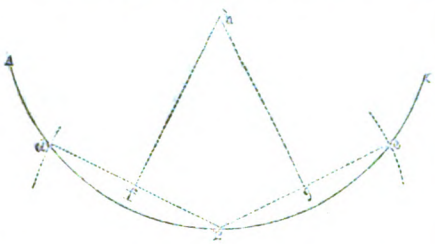
trouble of trying to make Bunsen's negatives from the materials named since an infinitely superior material must, if he can get coke at all, be within his reach, at, I may say, a gift, save and except the small labour requisite to put it into shape If he will apply at any gas-works in his neighbourhood for a lump of "gas carbon," a waste residuum found on the top of all retorts, the smallest coin almost will purchase a sufficient quantity to make plates enough from to form as powerful a battery as any amateur can require and its efficiency as a conductor is vastly superior (from the density of its mass) to any coke and treacle combination. If it should prove too much trouble for Carbon to cut his "negatives" from such rough blocks, let him apply per post to Roberts and Furst, Blue Boar-court, Market-place, Manchester, and he will be supplied with the right material ready prepared at a price I could scarcely believe, did I not know the fact. One of their blocks (cost 9d.) I cut into six plates with an ordinary tenon saw, and formed a battery therewith whereby I could produce all the phenomena requisite for private pastime and public lecturing except the electric light, and I do not doubt but that I shall shortly be able to produce even that from the same source combined with other apparatus.—WM. TONKES.

DIAMETER OF CIRCLE.—H. T. requires a simple way of finding the diameter of a circle when the size of an arc is given If he squares half the chord and divides this by the versed sine he will obtain a number which when added to the versed sine equals the diameter.—JOHN H. STACEY.

CENTRE OF CIRCLE.—Having seen in your last number of the ENGLISH MECHANIC the inquiry of H T., I give the following simple and practical method to find the centre of any circle, the arc being given. Let A, B, C, be an arc, required to find the centre—take any point B for a centre, and mark off B *d*, B *e*, equal to one another, and bisect



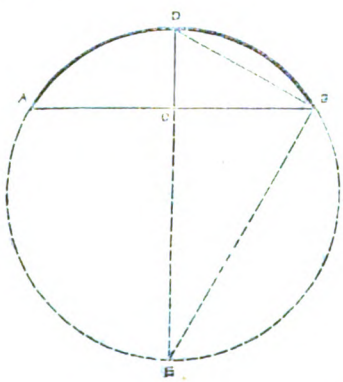
them at *f* and *g*, and erect lines *f h*, *g h*, at right angles to B *d*, B *e*, and where these lines cut shall be the centre *h*. H. T. can at once arrive at the diameter.—J. E. F. J. W.

DIAMETER OF A CIRCLE.—H. T. (ENGLISH MECHANIC, No. 44. p. 239) asks for "the simplest method of arriving at the diameter of a circle, the size of an arc being known." I would beg to submit to him the following :—

Let A D B be an arc, of which the chord A C B and the height C D are known (NB AC=CB).

If the circle A D B E be sufficient to be completed, and D C produced to meet the circumference in E, then D E is a diameter.

Join D B and B E, then D B E is a right angle (Euclid iii., 31), and D C is to C B as C B is to C E (Euclid vi., 8).



That is :—$DC \times CE = CB_2$. Whence $CE = \frac{CB^2}{CD}$

Add CE thus found to CD previously known, and we have DE, the diameter required.

Hence the following rule :—

Divide the square of half the chord by height of arc.

Add to the quotient the height of arc.

The result is the diameter of the circle.

Thus, if chord = 18″·625, and height of arc = 3″·825, we have half chord = 9″·3125,

And $\frac{9\cdot8215^2}{3\cdot825} = 22''\cdot67259$ nearly.

Whence diameter = 22″·67259+3″·825 = 26″·49759 nearly.

The result is less than one millionth of an inch in excess.—J. A. F. R.

ELECTRICAL MACHINE.—Let A. N. notice whether any sparks pass from the cylinder to the pin points, the points being placed as close to the cylinder as possible; if there is, the japan on the tin conductor is most likely the reason why he cannot draw sparks from it, and should be removed; but if no sparks pass from the cylinder to the pin points, then let him make metallic connection between the cushion or rubber and the ground so that he may draw his supply of electricity out of the earth.—MAGIS ET MAGIS.

ELECTRICAL MACHINE.—Although only an amateur, I have constructed several electrical machines which act exceedingly well, and by the aid of which I am able to perform a number of very pleasing experiments. I therefore beg to be allowed to respond to the appeal of A. N., in No. 43 of your excellent magazine. The principle upon which A N. has constructed his machine appears, so far as I can judge from his description, to be correct. I think, however, it would have been an improvement if the wood of which the supports to the cylinder are made had been, not merely well dried, but baked; this, although not an indispensable condition, would ensure against a loss of any portion of the electric fluid by being attracted thereto. I am inclined to think that the absolute failure to produce any effect was owing to an omission on the part of A. N., when putting his machine in action, namely :—to connect the cushion to the table or floor by means of a metallic chain; such a connexion is essential, since his cushion is insulated on a glass rod. It should be observed that the machine does not generate the electric fluid, but simply draws it from the earth. It has been aptly compared to a pump, the earth is likened to the well, the chain from the cushion to the suction pipe, the cushion to the sucker, the cylinder to the nozzle, and the conductor to the receiving vessel.—R. F.

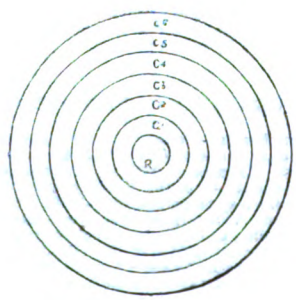
SECONDARY BATTERY.—I beg to thank Anion for the description he has given in the ENGLISH MECHANIC AND MIRROR OF SCIENCE, for January 26, 1866, No. 44, of the more powerful secondary battery, with coil of wire, to assist in charging the same, but am sorry to say that I do not quite understand it, and therefore shall feel greatly indebted to him if he will give a sketch so as to show: 1st. Where the connections are made with the coil of wire and contact breaker. 2nd. Where the connections are made with the coil of wire, &c, and primary battery. 3rd. Where the connections are made with the coil of wire, &c., and the second battery. 4th. And whether the sheet of lead and the sheet of amalgamated zinc have to be rolled up similarly to the sheets of lead of the previously described secondary battery or not.—DAVID BATHAM.

MAGNETIC ENGINES.—E. Maddock and T. T. Parkinson may use uncovered copper wire for Electro-Magnetic Engines, taking care to insulate the wire coils from each other and from the iron core, by means of cardboard or writing paper, the ends of which should overhang the coils of wire to prevent the current from overflowing as it were, and thus destroying the insulation. Machines of contact are not good, on account of the residuary magnetism offering resistance.—CARBON.

ELECTRO-MAGNET.—In your number of the 19th of January, Mr. G. Hudson kindly gives the method of making an electro magnet of the old style, that is, with covered wire. To construct the same article new style, take a similar horse-shoe bar, and gum or paste two or three turns of writing paper round each arm, about 4 inches up, but not round the bend, as that part does not add to the power. Now take half pound of No. 16 uncovered copper wire, and having found the middle of it, commence to wind on from the middle, and about 3½ inches from the end of the arm, winding down towards the end. When the wire reaches to within ¼ of an inch of the end, tie it down with strong twine, then paper the copper wire coil the same as in the first process. This is to insulate the second layer from the first. Then proceed to wind on the wire over the paper till it is all expended, leaving a short end, to which a binding screw is soldered for convenience of connecting with the battery. The process is repeated on the remaining arm, taking care to wind the wire in the same direction as at first. This electro-magnet will have 1-9th more power than the covered wire magnet, and on the score of economy will cost for wire 8d. against 1s. 9d.—CARBON.

ELECTRO MAGNETIC ENGINE.—In reply to E. Maddock and others, who are likely to construct an electro-magnetic engine, or experiment in magnetism, I offer the following suggestions, which I have intended trying myself, but cannot for want of time.

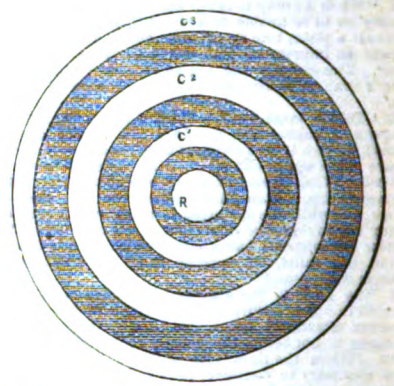
FIG 1



1. Construct a compound magnet by arranging a series of cylinders with a rod in the centre, as represented in section by fig 1. C, C2, to C5, are six cylinders, and R, a solid rod, all of hard steel.

2. Construct a compound electro-magnet as represented in section by fig. 2. R is the central rod, and C, C2, and C3, three cylinders, all of soft iron; W, W2 and W3, are three coils of wire. This wire may be insulated or not. The coils may all be wound in the same direction, or, what may be found better, in alternately opposite directions, each coil may be formed of one wire or any number of wires, each being separately connected to the poles of the battery, or they may all be formed by one unbroken length. In both figures the rods R may be omitted, the cylinders may be insulated from each other, a cap of thin soft iron may be formed to fit on the ends. These compound arrangements may be made in the form of a horse shoe or any other shape, but it is evident that any other shape but straight is almost impracticable; two straight ones may, however, be connected together by steel or iron in the usual way. If in the case of fig 2, it will be found necessary to wind the

FIG 2



wire in alternately opposite directions, it is probable that the cylinders nearest each other would exhibit opposite polarities. In either arrangement any greater number of cylinders may be employed, increasing, of course, the number of coils in fig. 2 accordingly. Mr. Tawse's proposal to utilize the electricity developed by the oxidation of a ship's sheathing is a grand idea, and well worth trying. Some of your correspondents, in commenting upon this proposal, seem to have misunderstood him. There is, however, one serious objection, which I think could not be so easily surmounted. It is the want of an equivalent for the copper element of the battery, for it is well known that a zinc plate (or its equivalent) alone would give no or very feeble signs of electricity, and to supply a copper plate in addition to the sheathing all round the vessel would be out of the question. But the sea is a vast reservoir, and would absorb any quantity of electricity given out by the sheathing, same as the earth by means of the embedded conductor absorbs the electricity given out by telegraph batteries. Query—Can the necessary electricity of an opposite kind to that possessed by the sheathing be supplied through a wire by a large surfaced conductor immersed in the sea, and connected to or forming part of the ship, and insulated from said sheathing?—J. H. M.

FRENCH POLISH.—With respect to French polish I have used various receipts, but the following is by far the most superior in its results, and the easiest of application :—

Shellac	1½ozs.
Gum Juniper	½oz.
Benzoine	½oz.
Mythylated Alcohol	½ pint.

Put these ingredients in a bottle, occasionally shake, and when the gums are dissolved it is ready for use. Obtain a piece of coarse linen or calico, then take about the size of an egg of cotton wool and apply it to the neck of the bottle until nearly saturated, and gently dip it into some finely powdered Dragon's blood, and place the cotton wool in the centre of the cloth, forming a pad, and after applying a drop of olive oil to the surface of the pad to prevent its sticking, it must be applied to the surface of the pad by rubbing in a circular motion, until the wood becomes dry. By giving it two or more coatings any amount of polished surface can be obtained, but polishing, like everything else, requires patience and practice. If it is desirable to imitate Ebony, use Lamp Black instead of Dragon's blood. It will of course be understood that the wood must previously be made perfectly smooth with sand or emery paper.—AN OLD HAND.

RESTORING LACQUERED WORK.—There are two methods for restoring lacquered brass work, which I shall describe The first is known, technically, as sharp-watering or saving, from the fact of its being much cheaper than the second, which involves the expense of dipping and burnishing again. Wherever the lacquer has preserved the surface of the metal from the air, the first method will generally be found to answer. If it does not then the second must be had recourse to. I shall first describe the apparatus required, and then the process for sharpwatering :—A pan (copper by preference), a stoneware basin or lead trough, two vessels of any description containing, one cold water, and the other hot, all large enough to contain the article when immersed; a strong solution of American black ashes or potash is now to be made up, and a weak pickle of nitric acid and water, half pound of ashes to about 1½ gallons of water, and about 1½ gills of acid to a gallon of water. The potash is now to be brought to the boil, and the article hung on a wire, passed smartly through it; it is then to be rinsed in the cold water, passes through the pickle, cold water and hot water, then well shaken, and dried with tissue paper, and immediately lacquered cold with pale lacquer to protect the surface of the metal till you are done sharp-watering. You must now heat the article on a hot plate, and apply the proper lacquer with a camel-hair brush. This will generally answer

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for work which is not entirely dirty, but when the boiling in potash and sharp-watering does not restore the colour, then the second method must be resorted to, which is as follow:—Boil off the articles in potash, wash in water, and then dip in aqua-fortis, taking care that there is no grease or oily matter on the metal; the time that it is kept in the acid must be determined by the colour you want, wash in cold water, heat in hot water, and dry in clean white saw dust, then burnish the prominent parts, and lacquer as before. The second method requires some little experience, but is easily acquired; be careful not to allow any iron to come into contact with the acid, and work with brass tongs or wire as the acid attacks the nails and discolours the fingers. I have supposed that the articles are all bright, but if they are black, green, or any other shade, a different treatment will be required, which I shall be happy to explain if your correspondent requires it, as well as the composition of the lacquers.—J. D.

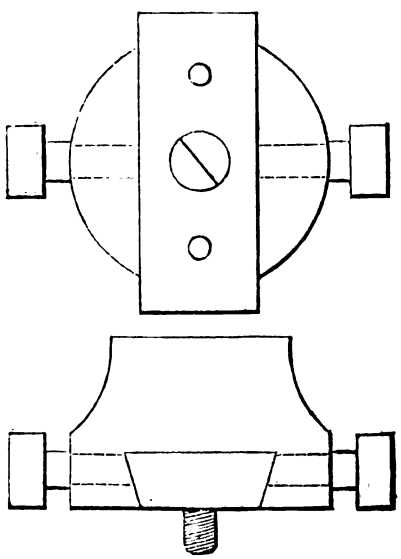
JAPANNING.—In answer to Reign Harker and John Ross concerning the process of Japanning Tin Trunks, &c., I shall be happy to correspond with these gentlemen privately, as the subject would occupy too much space for publication.—FLANDERS OWEN, 62, Blewett-street, Banes Well, Newport, Monmouthshire

COMBUSTION.—James Robertson.—The best plan to get rid of the smoke from an Argand gas burner, is to consume it, and this may be done by mixing the gas with a supply of air before burning. I give two plans, viz:—

1st. Place over the chimney of the gas burner a piece of wire gauze 30 to 40 meshes to the inch, this may be kept in its place by a collar, and when fixed, turn on the gas and light on the "top" of the gauze. It should burn with a pale blue flame and give very little light. The other plan is to go to any chemical apparatus maker and buy a Bunsen's gas burner, they cost from 2s. 6d. each. A substitute for one may be made by taking a ¾ elbow dish holder, remove the gallery and screw on a ¾in. coupler, which must have 4 holes bored into it in such a position that the tops of the holes will be in line with the top of the rib—these will supply air for the combustion of the gas, a piece of tube 6 inches long must be screwed to the coupler, and the burner is complete. When in use, care must be taken to turn on the gas a few seconds before lighting, and it will (and must) burn at the top of the tube similar to the first plan.—S.

VENTILATION.—If the rooms that Ventilator wants to ventilate have a fire-place in them, and he removes a brick out of the chimney wall so as to make a hole into the chimney *near the ceiling*, it will probably answer for ventilating the rooms; but provision must be made to close the hole in case foul weather should make the smoke come through it.—MAGIS ET MAGIS.

CHUCK FOR SCREWS.—T. E. M., if he wants to turn small pieces of Metal can have no better chuck than that described in No. 33 of the ENGLISH MECHANIC. If he wants to make screws I give him my plan: First, I turn them down to the size for screwing, next I screw them, then fix them in



a chuck, turn and polish the heads and notch them with a fine saw. I have made them for years, although I never saw one made with the exception of my own in my life. I send a drawing of a chuck. If he wants to turn anything with a female screw he must screw a piece in and rivet it as shown in No. 2. I have three sufficient sized holes to each piece.—ROBERT JEWELL, Woodseat.

LATHE MOTION.—In answer. Why not put back gear to it at once?—T. JACKSON.

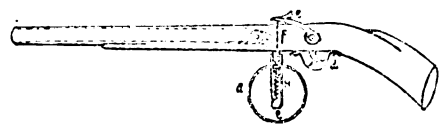
GEAR.—In reply to C. A. Woolnough. The cheapest reversing gear would be a Loose Eccentric. The best (and most complex) the Link Motion, and the best form of pump would be the common ram.—T. JACKSON.

PRACTICAL MECHANICAL DRAWING.—In answer to this correspondent. The best work (and I mean by that the most practical) I have yet found is the "Practical Draughtsman's Book of Industrial Design," published by Longman and Co. For Gear Wheels construction, for Locomotive Engines, see "Recent Practice on," by D. K., Clarke and Colburn.—THOMAS JACKSON.

BOILER MAKING.—In reply to David Wood's query on boiler making. I believe there is not such a work as he seems to want, there are only 2 slight wood cuts in Mr. Fairbairn's treatise on "Mills and Millwork," vol 1st, Prime Movers). I think he would get the best, and the most minute information by taking, say, one boiler of each class, and making a general drawing, and then detailing the various parts; also, read Fairbairn's useful information, for strength of plates and rivets.—THOMAS JACKSON.

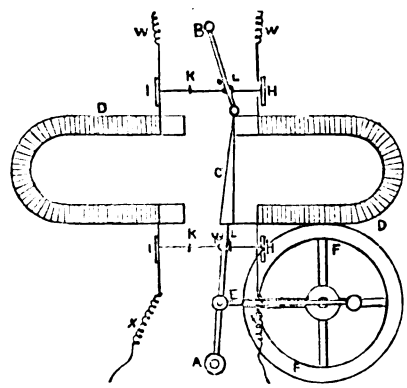
SAW FOR FELLIES, &c.—In answer to Wheelwright, the saw I have in use for fellies is a blade about 25 inches long and about 1¼ inch wide, fixed in a frame about 2 feet wide, of 1¼ inch sides (wood)—larger top and bottom—2½ inch deep by 1¼ inch. The saw is fastened with a nut and screw to keep it tight. To operate, fasten the wood on the bench with a bench dog, lay hold of the saw nearly at the top of the side, and work it up and down as in a pit, standing behind the saw and working it from you. I find a handsaw of little use in comparison. I have found it of great use to me when burnt at the fire to rub on white lead and linseed oil over the place. The mixture soon dries on. To remove nuts from screws set with rust, heat them red hot, and put them in water till cold.—HARRY.

AIR GUN.—At the request of C. N., per ENGLISH MECHANIC of the 19th inst., I send a rough sketch of an "Air Gun," which I hope he may find intelligible. It resembles a common fowling piece, with the addition of a hollow round ball *a*, this ball is suited with a small valve *b*, opening inwards, and into it there is air forced by means



of a syringe, the ball is then screwed to the barrel of the gun, and the bullet *c* rammed down, the trigger *d* is then pulled back which throws the doghead *e* on the pin *f*, connected with the valve which opens it, and admits the condensed air up *g*, and into the barrel, which, of course, impels the bullet; the spring H is for keeping up the valve tight. The round ball for the condensed air is in some guns dispensed with, and the stock I made hollow, and air compressed into it. There are in fact many kinds, but those just mentioned will kill at 40 or 50 yards, and impel a great many charges. Of course that will diminish in effect as the air becomes less condensed.—JOHN AGRICULTURIST.

ELECTRIC MAGNETIC ENGINE.—Some of your correspondents being desirous of making an electro-magnetic engine with all the latest improvements and something more, I send you the enclosed sketch. I have meddled with these things for some years. This is drawn from memory, and



as an attentive spectator I only saw it do its work well, without any breakdown whatever, and to be under perfect control. It propelled the boat I mentioned in a reply to Mr. Tawse, in No 33. Its action is so simple that it cannot fail to be understood by anyone at all "up" in the subject.—R. W. WILLIS.

FIXING PICTURES.—In answer to Tyro, let me say that simple immersion or soaking in water is sufficient to fix pictures on paper, prepared with bi-chromate of potash only, but that process will not give any satisfactory results for the purpose he mentions. He will obtain very beautiful results by following the photographic printing process on albumenized paper.—AN OLD HAND.

THE CARBON CYLINDER is made by intimately mingling one part of caking coal and two parts of coke, the proportions varying according to the caking property. Some add to the mixture 2 parts of rye flour. The mixture is introduced into a cylindrical mould of sheet iron, in the centre of which is placed a case of wood or pasteboard, to facilitate the escape of gas during calcination. The mould should be closed by a moveable cover well fitted on and luted; the whole heated gradually to redness, and the calcination continued until the disengagement of gas ceases. The cylinder may be finished with a file or saw, or on a lathe. Before proceeding to this last operation in order to increase the cohesiveness of the cylinders, it is necessary to soak them in a strong solution of molasses, dry them, and subject them to a very intense calcination. On the top of the cylinder a copper ring is fastened, to which a strip of the same metal is soldered. The carbon may be made in a rectangular mould, but must be enclosed as soon as possible.—T. K. K.

STAIN AND POLISH.—The best stain to imitate mahogany I have tried is the following:—Any kind of wood will do, but the closer the grain the better, and the surface must be perfectly smooth. Take 1 oz. of Nitrocis acid (not Nitric acid), and mix with 1oz. of rain or distilled water, then with a piece of clean rag rub a little of the solution over the wood.

Next prepare the following solution:—

Finely powdered Dragon's blood	½oz.
Mythylated Alcohol	½ pint.
Carbonate of Soda	2 drams.

Dissolve and filter.

Lay this solution on the wood, previously prepared as above, with a soft broad brush, and when the first coating is dry, repeat the layer of colouring, until, when dry, the surface appears quite glossy and of the colour required. When the polish becomes "deadened," the brilliancy may be restored by the use of a little cold drawn linseed oil. The surface can be French polished by previously deadening the surface with sand paper.—AN OLD HAND.

W. W. WILLEKES MACDONALD.—In answer to the inquiry of J. W. Wilekes MacDonald, in No. 44, vol. 2, I would recommend to him the "Engineer's and Machinist's Drawing Book" by Blackie and Son, 44, Paternoster-row. The price is £2 2s., bound, or in 16 Parts 2s. each. It is the best book I have seen on the subject.—SIMON DE MONTFORD.

BETA'S GASHOLDER would weigh close upon 2 tons with all the necessary fittings. It is altogether too thick, ¼th of an inch being quite stout enough for his purpose.

SCALE OF STEAM BOILERS.—T. E. D. asks for a remedy for clearing the scale off steam boilers, but as his object would be better answered by preventing its formation, I give the following as the result of several years' experience with the hope that it may be useful to many readers of your excellent publication. Except in some few localities the bulk of the deposit in steam boilers is a salt of lime—generally a carbonate, and as water is incapable of retaining but a very small quantity of this salt in solution, the remainder on the evaporation of the water is precipitated and becomes firmly attached to the iron in the form of scale. To keep this salt in a soluble state I use for a 20-horse boiler 8 ounces of muriate of ammonia (common sal ammoniac) per week, this decomposes the carbonate of lime, forming muriate of lime and carbonate of ammonia—the first being soluble is blown off by opening the mud tap twice a day for a few minutes, and the latter being volatile passes off with the steam. A boiler treated regularly in this way will never require scaling, the slight deposit being in a powdery state and easily removed with a hard brush. It is not advisable to use a larger quantity of the muriate of ammonia as its action is very energetic, and if there is not sufficient lime to effect its decomposition it would be liable to act on the iron itself—the proportion given for a 20-horse boiler is, however, perfectly safe.—JOHN H. STACEY.

SUN AND PLANET MOTION, VELOCITY OF RIVERS, &c.—I beg to acknowledge the obligations I am under to Messrs. James Sharpe, and Wm. H. Thompson, for the notice they took of my description of "Watt's sun and planet motion," and the kind manner in which they spoke of my shortcomings. I would like however to ask these gentlemen a question:—

How does Mr. Sharpe account for the almost universal use of the crank, and the rejection of the "sun and planet" motion, which he considers (judging from the tone of his letter) to be an improvement on the crank? To Mr. Wm. H. Thompson, I put the following question:—How could a wheel suspended at the end of a comparatively loose bar of metal, work into another wheel regularly and mechanically without their centres being connected? In No. 42 of your excellent journal Greenholme asks how to find the velocity of rivers. A very simple way which I have often tried, and always with success, is,—Attach a piece of cork, or any other bouyant substance, to the end of a tape line, let the cork float away with the stream, and at the end of one minute (by a watch) stop the onward motion of the tape line, and the length of tape "run out" will be the velocity of the river per minute.—DAVID SLOAN THOMSON.

COMBUSTION.—You must apply Bunsen's arrangement for burning the mixed flame of chemists unattended by danger. This can be done very cheaply, by fitting a small perforated tube over your jet, so as to mix the gas and atmospheric air before ignition. This will give a flame of high heating, but of a low illuminating power which does not deposit unconsumed carbon. The tube may be either brass or iron, and is made to slip on to the jet with a clearance of a ¼ inch all round the burner; 3 holes about ¼ inch diameter are drilled through the tube just below the jet, and the flame is lighted at the top of the tube, which should be about 4 inches long. Care is to be taken that the air is only supplied by three holes, and that the flame does not burn at the jet, but at the top of the tube. The tube is to be fitted so as to be easily slipped off and on when required. Or a cylinder of sheet-iron covered with wire cloth and pounded pumice stone may be set over the jet, with perforations at the bottom of the cylinder to admit the air and the light applied above the pumice stone; but this is neither so safe nor so convenient as Bunsen's arrangement, works admirably which—J. D.

M. SIMONIN has been experimenting upon the air of mines in relation to pressure on the barometer. His inquiries have not enabled him to form any general laws; but the mean of four experiments at the coal mines of Creuzot and Epignac gave a rise in temperature of 1 deg. Centigrade for every 45 metres of vertical descent, and a rise of one millimetre in the barometer for every 10½ metres of vertical descent.

IT has been suggested that the moon may have a comparatively dense atmosphere, and that there may be vegetation on those parts called seas.

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ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

A BOON IN NEEDLES.—If our lady correspondent will send to the firm at Redditch, she will doubtless have all her wants supplied. The article, we understand, is only "feeling its way" in the trade, against a very strong opposition.

J. P. WARD.—You will excuse us for not seeing the improvement you suggest - it is sacrificing one power over the vehicle to gain another, which we should not advise. You certainly, however, deserve every credit for your exercise of the talent given you. With respect to the attachment of the Lenoir engine, Mr. Parker, of Lilford-road, Camberwell, makes a road locomotive at, we believe, a very low figure, capable of taking two or three persons at a cost of next to nothing per hour. Respecting the "infringement," your using the same arrangement before the patenting of that to which you refer should not deter you from working it; rather it upsets the patented article. If you fancy we are wrong in the opinion given on the velocipede, do not hesitate to write again, giving your reasons.

A. M. G. (Paisley).—There have been several excellent works published in Edinburgh, by an Edinburgh painter, but we forget the name. Were you to send a stamped envelope and your inquiry to McPhun, bookseller, or to Blackie and Co., Glasgow; or to A. and C. Black, Edinburgh, very likely you would get what you require.

J. F. (Wolverhampton).—We have now in our possession—the accumulation of only twelve days—some three dozen of slide-valve ideas, every one of them, nearly, having something good; but, with the exception of some half-dozen, all have been tried, and some now in work. Yours is among the half dozen, and we think it will do. The question is, will it do better than others in vogue? That is difficult to settle. If its self-adjustment be "the thing," then we think it stands a very fair chance indeed; nor do we know of any one exactly like it in the particulars.

JAMES WALLACE.—We have inserted your inquiry in another place; we are not acquainted with either maker or seller. When you are next in Manchester you might inquire at Muir's, Britannia Works.

HARRY.—Thanks for all your favours. See elsewhere. We think that a Weston's pulley will just suit you, so far as we understand your requirements. Respecting the Society, we cannot give any opinion. Get its rules and last balance-sheet, and consult any one of your friends connected with *another* society if you cannot come to a conclusion yourself.

J. H. M.—Obtain the book reviewed in the present number.

J. K.—In the last two numbers of *The Builder*, published in York-street, Covent-garden.

N. N. N.—Why not advertise for some one with capital to join you in a patent?

BASIL VALENTINE.—Your scheme shows a considerable amount of ingenuity; but it too closely resembles others already in work to claim a patent right.

JOHN JARDINE.—Send us a full account, and we shall be able to give an opinion. Such secrets are, of course, kept to ourselves.

A. MILLER.—In our opinion it would scarcely be safe, but so much depends on the construction, that we advise you to consult a practical engineer on the spot.

W. H. L.—We will endeavour to obtain the information.

J. C. PHILLIPS.—Other drawings will shortly appear.

PHANTASMAGORIA.—See answers on Magic Lantern in last week's number.

GORDON, J.—See "Replies to Queries" in present number,

THOS. BRADSHAW.—Rub it over once or twice with soft soap.

CARROW.—We readily accept the offer.

F. H. H.—There must be something very faulty in the firing arrangements of the larger engine. State the whole case as concisely as possible, and forward it to us. When inserted, it will be strange if you do not receive much useful information from some of our locomotive friends. Thanks for the other portion of your communication.

JOHN GUTHRIE.—Thanks; but too late.

YOUNG IDEA.—Your views are perfectly correct, but we cannot spare space for insertion.

CHIPS.—Write to Weale, Bookseller, High Holborn.

JOHN TAYLOR.—Forwarded.

B. PERRY.—Too late.

E. BLACK.—To do so you must have a vessel of a different construction.

FREDERICK JOHNSTON.—We thank you for the suggestion, but cannot at present make any alteration.

F. J.—Thanks.

X. V. M.—We do not think it our province to recommend any particular firm. Why not consult the advertisement pages? Many articles naming the best books on turning have recently appeared in these pages.

ALFRED ALLEN.—Write to Mr. William Muir, John-street, Adelphi, and you will receive the information you require.

THOMAS FAIRBAIRN.—It is not our custom to answer by post. Many of the books are scarce, and would have to be obtained through such booksellers as Spon, Weale, or Lockwood, they are mostly illustrated by diagrams.

EDWARD LEE.—If the instrument saves much time and labour, it will be worth patenting; but we advise you to seek the advice of some honest agent. 2. There is some talk of the work being completed next year.

LEEDS, STEAM BOILER DOME.—Thanks for the great trouble you have taken. We received numerous letters on the subject, and yours too late for insertion.

DAVID KNIGHT will perceive, on referring to "Replies to Queries," that his communication came to hand too late.

AN OLD HAND.—You hit hard, but we take it all in good part. Such errors are disgraceful. The work requires much more careful reading and revising.

DAVID WILLIAMS.—1. Yes; but expensive. 2. Three lines might be used, but the expenses of the company would be materially increased in every way. 3. We have before heard that Mr. Aytoun's plan was only an improvement upon an old working. 4. We cannot promise anything on Knots at present.

SIMON DE MONTFORD.—We are informed that the machines answer very well.

INCUBATOR.—1. If you cannot obtain gas, try sperm oil in a manner similar to the Wardian forcing frame, sold by many seedsmen and florists. 2. Read the articles on Telegraphy, now being published in this journal, and also the back numbers.

APPRENTICE.—We know of nothing sufficiently hard.

T. W.—In our next.

BURY (Lancashire).—We received numerous answers. Yours came to hand after the selection had been made.

F. J.—The prints require no varnishing or further treatment.

SILAS will find all he requires by looking through the back numbers.

A. M.—Common enough in the electric clocks.

S. APPLETON.—We shall be glad to receive the papers on gas burners.

DAVID SOUTER.—We cannot discover where the offices are removed to.

D. V. L. C.—About £80.

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

214. William Edward Gedge, 23, Southampton-buildings, Chancery-lane, an improved generator for steam engines.—A communication.

215. Thomas Baker, Station-road, Forest Gate, improvements in sash fastenings, which improvements are also applicable to other purposes.

216. Joseph Dare, jun., B. A., 8, Burton-street, Burton-crescent, improvements in pyrotechnics.

217. Richard Henry Bore, 55, Globe-road, Mile End, an improved syphon for drawing off liquids.

220. William Brookes, 63, Chancery-lane, improvements in the mode of producing mechanica motion.—A communication.

222. François Wibratte, Paris, a new or improved vehicle for carrying the electric wires in submarine telegraphs, so called "Submarine electric telegraph tube chain."

224. Richard Moreland, jun., Old-street, improvements in the construction of fire-proof floors for buildings.

228. Mark Sylvester, Gilbert-road, Kennington-lane, an improved compound for removing and preventing incrustation in steam boilers.

247. William Winter, Leeds, an improved feed motion for sewing machines.

249. George Dyson, Lindley, Huddersfield, an improved means of splicing or joining straps or driving belts for machinery.

254. David Jones, Commercial road, improvements in window fastenings.

257. François Louis Roux, 27, Rue Laffitte, Paris, improvements in the mode of and apparatus for applying copper sheathing to ships constructed of or plated with iron.—(Complete Specification.)

258. Jean Marie Armand Montclar, Glasgow, improvements in the manufacture of materials or compositions for decolorising or purifying saccharine or other liquids, and for making paint, blacking, and foundry blackening, and in apparatus therefor.

263. John Henry Johnson, 47, Lincoln's-inn-fields, improvements in apparatus for lubricating purposes.—A communication.

267. Marc Antoine François Mennons, 8, Southampton-buildings, improvements in the mode of and apparatus for compressing air or aeriform fluids for the generation of motive power and other purposes.—A communication.

274. William Willmer Pocock, Craven-street, Westminster, improvements in gas meters.

279. Alfred Arthur, Brighton, improvements in hydraulic machinery.

*** Specifications will be forwarded from the Commissioners of Patents Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

GOLD LACQUER.—Put into a clean four-gallon tin one pound of ground turmeric, one and a-half ounces of gamboge, three and a-half pounds of powdered gum sandarach, three-quarters of a pound of shellac, and two gallons of spirits of wine. When shaken, dissolved, and strained, add one pint of turpentine varnish, well mixed.

MEETINGS FOR THE WEEK.

TUESDAY.

Civil Engineers, 8. 1. Discussion on "The Craigellachie Viaduct." 2. "The Grand River Viaduct, Mauritius Railways." Pathological, 8 Anthropological, 8. Royal Inst., 3. Prof. Tyndall, "On Heat." Geologists' Assoc., 7.

WEDNESDAY.

Society of Arts, 8. Renewed discussion on Mr. Hawes' paper "On the Proposal that Railways should be purchased by Government." Geological, 8. 1. Mr. W. T. Locke Travers, "On the Mode of Formation of the Lake basins of New Zealand." 2. Mr. Robert Dawson, "On the Occurrence of Dead Littoral Shells in the bed of the German Ocean." 3. Mr. T. F. Jamieson, "On the Glacial Phenomena of Caithness." Pharmaceutical, 8. R. Society of Literature, 4½. Archæological Assoc. 8½.

THURSDAY.

Royal, 8½. Antiquaries, 8½. Royal Society Club, 6. Royal Inst., 3. Professor Tyndall, "On Heat."

FRIDAY.

Astronomical, 8. Annual Meeting. Royal Inst., 8. Mr. Archibald Smith, F.R.S., "On the deviation of the compass in iron ships."

SATURDAY.

R. Botanic. 8½. Royal Inst., 3. Prof. Westmacott R.A., F.R.S., "On Art Education."

PROPERTY RECORD.

SALES AT GARRAWAY'S.

BY MR. ROBERT REID.

Leasehold ground rents, amounting to £19 5s. per annum, arising from Nos. 7, 8, 10, and 11, Charles street aforesaid, term similar to above—£140.

Leasehold residence, known as Brierly Villa, Willesden-green, Middlesex, with coach-house and stable, let at £60 per annum, term 83 years unexpired, at £10 10s. per annum—£950.

Leasehold residence, known as Christ's College, Rectory grove, Clapham, with grounds of about two acres, let at £180 per annum, term 28 years unexpired, at £110 per annum—£215.

Leasehold house, with shop, being No. 2, Lowdnes-court, Regent-street, let at £50 per annum, term 62 years unexpired, at £12 per annum—£625.

Leasehold house, being No. 1, Brown's-court, Marshall-street, Golden-square, let at £26 per annum, term eight years unexpired, at £8 11s. per annum—£52.

Leasehold house, with business premises, being No 22, Broad-street, Bloomsbury, estimated annual value £34 term 24 years unexpired, at £36 per annum—£310.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Supply and delivery of second-hand rails, chairs, fish plates, fir sleepers, &c., to the War Department.—Particulars at the Office of Works, Royal Arsenal, Woolwich.

Erection and finishing of buildings connected with the Gateshead New Town Hall.—Particulars on application to Mr. Borrier, Townhall, Gateshead

Erection of Bacon Curing Works at Cirencester.—Particulars of Messrs. Cole and Son, Cirencester.

Rebuilding the Parish Church of Bloxwich, near Walsall.—Particulars at the office of Mr. Stanley, Solicitor, Bloxwich, Staffordshire.

Erection of two houses for the directors of the Bedford Freehold Building Land Company.—Particulars of John Usher, Esq., 44 High Street, Bedford.

Construction of a Bank for the enclosure of land in the estuary at North Wooton, near King's Lynn and other works. Particulars at the Engineer's Office, King's Street, Lynn.

Brickwork, labour only, of two first-class houses at Kensington.—Particulars of Messrs. Welchman and Gale, 26, Prince's Terrace, Prince's Gate, S.W.

Erection of a new Wood and Brick Church, at Talke, North Staffordshire.—Particulars at the office of Thomas Sherrett, Esq., Talke, North Staffordshire.

Erection of a House and Shop at Newhaven, Sussex.—Particulars of Mr. Thomas Stone, South Lane, Newhaven.

Erection of Alcoves, Terrace, Walls, Stone Balustrade, &c., in the private gardens at Saltburn-by-the-Sea.—Particulars of J. E. Macney, Secretary of the Saltburn Improvement Company, Darlington.

TENDERS SENT IN FOR BUILDING WORKS.

For erection of tavern, &c. Quantities by Messrs. Pain and Clark:—Public house and fittings, £2,891; Private house, £335; Shop, £380; Sundry works, £403.

For eight pairs of semi-detached cottages, at Wimbledon, at per pair. Mr. T. H. Hill, architect:—Gay, £437; Harmer, £392; Crouch and Son, £375.

For a new warehouse in Wimbledon Street, Leicester. Quantities supplied. Mr. Francis Drake, architect:—Johnson, £5 494; Osborne, Brothers, £5,367; Cox, £5,191; Kellett, £5,138; Porter, £5,073; Hutchinson and Son, £4 853; J. H. Johnson, £4,750

For alterations at Church House, Stanwell. Mr. F. C. Clark, architect:—Oades, £891; Hardy, £670; Tye and Andrew, £667.

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INDUSTRIAL EXHIBITIONS.—There has just been opened in Liverpool the first working men's industrial exhibition ever organised in that city, and the result is in all respects satisfactory to the promoters. There are 396 articles exhibited, many of high merit, and some of great curiosity and value.

The great reaping machine manufacturer, M'Cormick, of Chicago, has given 10,000 dollars to Washington College, Virginia, of which General Lee is president, to establish the M'Cormick professorship of mechanics.

THE ATLANTIC AND GREAT WESTERN RAILWAY.—The traffic receipts of this line for the year 1864, and with 322 miles open, were 3,709,980 dollars, whereas in 1865, with 490 miles open during the last half of the year, the receipts rose to 6,642,856 dollars.

THE green colour of gold leaf when seen by transmitted light may be destroyed by subjecting the metal, extended on glass or mica, to heat, a temperature as low as that of boiling oil being sufficient, if continued for several hours. When pressure is applied to such discolored gold by a convex piece of crystal of short radius, the green color of the transmitted ray reappears.

During February, the planets Mercury, Jupiter, and Saturn, will be morning stars. Venus will rise nearly with the Sun throughout the month, and will, therefore, be unfavourably situated for observation, and Mars will precede the Sun nearly an hour. The following will be the Moon's changes:—Last Quarter, Feb. 7, at 7h. 39m. p.m.; New Moon, Feb. 15, at 10h. 13m. a.m.; First Quarter, Feb. 22, at 4h. 48m. a.m.—*Illustrated London Almanack.* The constellations Ursa Major, Leo Minor, and Leo, will be on the meridian about midnight, near the middle of the month.

A memoir upon the height of waves at the surface of the sea, by M. Coupvent des Bois, giving the results of his observations during a voyage in the Astrolabe in the southern oceans, was read at a recent meeting of the Academy of Sciences at Paris. He found the waves in a smooth sea to have an average height of 0·6 metres, and those in a very heavy sea to attain a height of 8·7 metres (about 27 ft.). The highest waves were observed between Australia and Adele Island. The author states that by his investigations he has not discovered any relation to exist between the height of the waves and the velocity of the wind. At the same meeting a paper by M. Galy-Cazalat was read, in which he gives details of a new process for converting, rapidly and economically, a large mass of cast iron into pure homogeneous cast steel.

DRAINING PUMP.—The object of the invention of Mr. W. S. Nelson, of St. Louis, is an improvement in pumps, adapted more especially for draining purposes, because it is not liable to be put out of order or to be stopped up in pumping muddy and refuse water. It consists of a hollow cylinder, within which are placed two series of vanes whose adjacent ends are connected, although each series, in other respects, is distinct from the other in form and position. Those vanes which are nearest the induction end of the cylinder are nearly straight, while those of the other series are spiral. The latter, moreover, are surrounded by a circular case, which nearly fills the cylinder, and they are mounted upon a hub or axis, whose diameter is about one-half the diameter of the cylinder. Next to this series of vanes is a frame containing four radial blades, fixed within the cylinder, each blade being in a plane parallel with the axis of the cylinder. Their purpose is to counteract the tendency of the water to rotate after it has left the vanes, and direct it onward toward the place of discharge.

MINERAL WATERS.—A recent report presented to the French Academy contains the following statements:—1. A new spring at Enghien, called the "Source de Boulquet," has a sulphohydrometric value of from seventeen to nineteen degrees. 2. The waters of Seroille contain bicarbonate of soda. 3. The waters of Salies are highly charged with chlorides of sodium and magnesium 4. The waters of Bagnolo di Corneto, near Civita Vecchia, contain a large proportion of chloride and sulphate of sodium, but their medicinal properties have not yet been established.

ART NOTES.

LAST week Professor R. Westmacott, R.A., F.R.S., delivered his second lecture on "Art Education." He began by describing the gradual progress of ancient art, Egyptian and Assyrian sculpture occupying a large share of attention. He then spoke of the three Greek schools, under Phidias, Praxiteles, and Sisyphus, and told how Phidias broke through the conservatism of custom by departing from ancient types, and introducing beauty and nobility in sculptural art, wherefore he was much persecuted by his compeers, and probably lost his life by violence. Polychomy in statuary was next strongly condemned by the lecturer, who characterised the practice as "abominable." He concluded by narrating how sensuous sculpture began to predominate, and how it resulted in the gradual fall and decline of art.

AMONG the many claims of the Society of Arts to the gratitude of the community there is none for which it deserves more commendation than for its efforts to encourage art-workmanship by means of prizes to art-workmen. Yearly its list of such prizes has increased in number and value, and last year the sums offered reached collectively a very considerable amount. There has, however, we regret to say, been but little corresponding effort, or recognition of the society's liberality on the part of art-workmen. Various plausible explanations were offered for the comparative failure of former exhibitions of competitive works, but similar explanations can scarcely be offered now; and yet the display at present on view in the lower room of the society's house in the Adelphi is much smaller in number, and not superior in merit to those of former occasions. Similar failure has attended the offering of prizes by the architectural and other societies, and it may well be questioned whether such inducements are any incentive except to those few who are almost certain of winning some prize, but to whom it is often hardly worth while to compete; and whether, with the same expenditure, better means could not be devised for encouraging and assisting larger numbers. Among the competitive specimens now on view the carvings are the most numerous and praiseworthy; and, so far, the evidence afforded of advance within recent years in this important branch of art-workmanship is gratifying.

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	96	0	0	0	0	0
Sheet	do	101	0	0	0	0	0
IRON.							
Pig in Scotland	per ton.	3	5	6	cash.		
Welsh Bars, in London	do	7	15	0	0	0	0
Wales	do	7	0	0	0	0	0
Staffordshire	do	8	10	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
LEAD.							
Pig, Foreign	per ton	20	12	6	21	0	0
Red or minium	do	22	10	0		—	
QUICKSILVER	per bottle	7	18	6	8	0	0
STEEL.							
Swedish faggot	per ton	16	0	0		—	
,, Kegs	do	15	0	0		—	
TIN.							
English Block	per ton	102	0	0		—	
,, Bars	do	103	0	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.
Teak	11	10	12	10
Quebec, red pn.	3	5	4	15
yellow pine	2	15	3	10
Memel	0	0	0	0
elm	3	10	5	0
Dantzic oak	3	10	6	0
fir	2	5	3	10
Memel fir	3	0	3	10
Riga	3	5	3	10
Swedish	2	0	2	10
Masts, Quebec, rd. pine	6	10	8	10
yellow pine	5	0	6	0
red pine	0	0	0	0
Lathwood, Dantzic	5	10	6	10
St. Peter's	7	0	8	0
Yellow Pine, per reduced C.				
Canada, 1st qual.	17	0	19	10
2nd do	12	10	14	0
St. Petersburg yel.	10	10	12	0
Finland	8	0	10	0
Memel	0	0	0	0
Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	6
Staves, per standard M.				
Quebec, pipe	80	0	85	0
puncheon	20	0	25	0
Baltic crown pipe	170	0	190	0

MISCELLANEOUS.

	£	s.	£	s.
PUMICE STONE pr ton	5	0	8	0
OILS, &c.				
Seal, pale pr. tun	50	0	0	0
Sperm body	116	0	117	0
Cod	51	0	0	0
Whale, 8th Sea pale	48	0	50	0
Olive, Gallipoli	59	0	0	0
Cocoanut, Coch. ton	51	0	52	0
Palm, fine	41	10	0	0
Linseed	36	10	0	0
Rapeseed, Eng. pale	56	0	7	0
Cottoo, seed	34	0	40	10

LONDON COAL EXCHANGE.

PRICES OF COAL PER TON.

Bate's West Hartley, 15s. 6d.; Buddle's West Hartley, 16s. 3d.; Holywell Main, 17s. 6d.; Tanfield Moor Butes, 15s. 3d.; West Hartley, 16s. 3d.; Walls End Harton, 15s. 6d.; Eden Main, 16s.; Walls End Hetton, 18s.; Lyons, 15s. 6d.; Walls End Peusher Primrose, 16s. 6d.; Walls End Stewart's, 17s. 6d.; Walls End Cassop, 17s.; Walls End Hartlepool, 17s. 6d.; Walls End Heugh Hall, 17s.; Walls End Kelloe, 16s. 6d.; Walls End East Hartlepool, 17s. 6d.; Walls End South Hartlepool, 16s. 6d.; Walls End South Kelloe 17s.; Walls End Tees, 17s. 6d. Shaw's Hartley, 18s. 6d.; Walls End North Staffordshire, 17s.

THE MECHANICS' EMPLOYMENT LIST.

SITUATIONS VACANT.

SILVER ENGRAVER.—A good general hand. Apply, J. B. Sly, 9, Rathbone-place.

DIE SINKER.—A first-class workman Apply, J. B. Sly, 9, Rathbone-place, London, W.

IRONMONGER.—Junior Assistant. Apply at 123, Holloway-road.

OIL and COLOUR TRADE.—Manager.—Apply to Mr. G. M. Smith, 199, High-street, Borough.

IRONMONGER.—Junior assistant, understanding the General and Furnishing Trade. Apply to J. Giles, New Brentford, Middlesex.

SMITH.—Wanted, a Steady Man, used to the fire, railing and jobbing work. Apply personally, at 40, Queen's-road, Notting hill.

MACHINIST WANTED, to keep in repair a number of Sewing Machines. Apply, by letter, to W. C., 13, Basinghall-street, City.

TRAVELLER WANTED, by a Sewing Machine Company. Apply to S. M., care of Messrs. Wordley and Co., 56, Lord-street, Liverpool.

HARMONIUM FINISHER.—Apply to Julius Layland and Co., 67, Blackman-street, Borough.

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TO BUILDERS' CLERKS.—Wanted, a Competent Person to Superintend, in the absence of the principal. Apply to H., 186, Strand.

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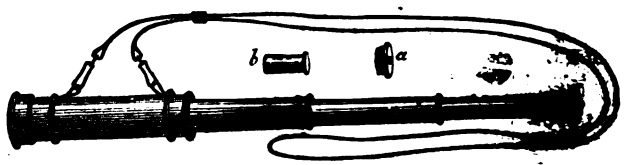

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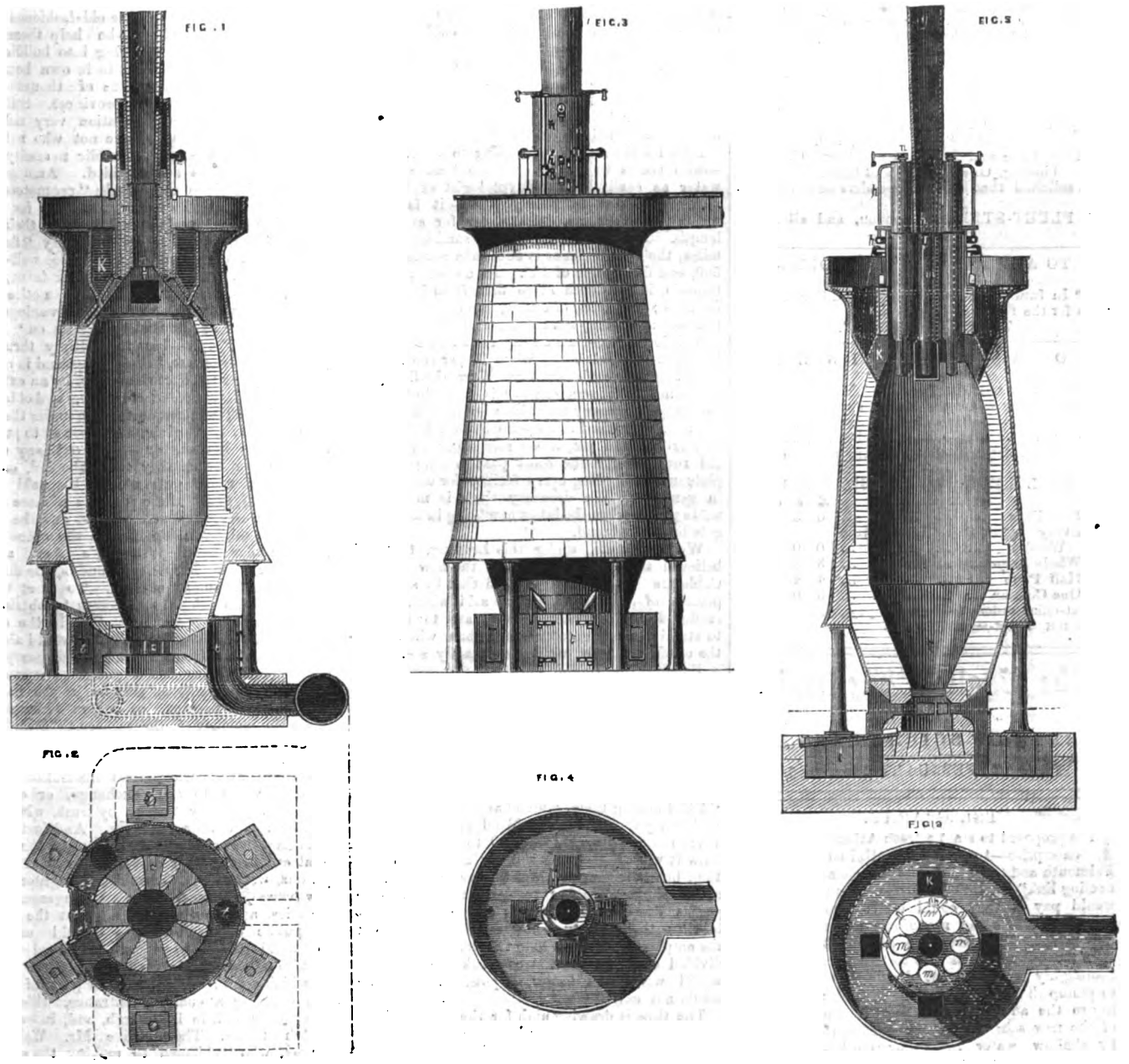

MESSRS. WOODWARD'S IMPROVEMENTS IN MELTING AND SMELTING FURNACES.

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FRIDAY, FEBRUARY 16TH, 1866.

TELEGRAPHY.

IT is proposed to start a fresh Atlantic Telegraph enterprise—to reach the United States *via* Falmouth and Cape Cod, and to use as the "connecting link" Macintosh's Cable. As twenty lines would pay if they could be laid securely and cheaply,—first being manufactured faultless,—we may start by expressing the hope that every possible means may be used to test this new-old cable thoroughly before any set of subscribers are asked to plump their money into the Atlantic. According to the advertised statement of the promoters of the new scheme, the proposed route is divided by shallow water into four parts—Chauisser's Bank, Milne Bank, and Newfoundland Bank; so that, in case of accident, the cable can be readily recovered for repairs. The peculiarities of the Macintosh system consist in using a new insulating material, composed of chlorodine, paraffine, and india rubber; and it is affirmed that this will give a rate of 80 per cent. more signalling power than was obtainable with the late Atlantic cable. At a meeting held the other day in connection with the new scheme, a specimen of the Macintosh cable was exhibited, which was about five-eighths of an inch in diameter, light and flexible. The patentee had offered to lay a cable from Valentia to Newfoundland, for £100,000. In explanation of the lowness of this figure it may be stated that all external wires are dispensed with, and the mechanical strength requisite for the cable is obtained from the insulating material, so that all superfluous weight is avoided, and an excess of strength obtained, which renders the cable capable of sustaining twenty miles of its length in water. This, it must be remembered, is the promoters' statement; we have no figures by which to test the matter; though itought in justice to be stated that various scientific men are in accord with Mr. Macintosh. The conductor consists of a series of five copper wires laid longitudinally, and held together by the insulating material, which it is to be hoped will not give out, when "sunk to the bottom of the sea." The cable is to be constructed in one continuous length, without joints or welds. The plan was brought before the British Association eight years ago, and has been tested by Professor Miller and Mr. Fitzgerald; and Professor Miller has stated that the insulating materials are of the most unalterable description.

Now for the route. According to Capt. Selwyn—who seems to "read off" the land under the water as easily as an Egyptologist explains the meaning hidden in hieroglyphics—it is one in which there is no deep water for any great length. The distance to the first sand-bank is 900 miles, the next distance is 500, then comes another 500, and finally one of 450. In no case, says the Captain, is the depth more than from 100 to 200 fathoms; and that, of course, is a mere flea-bite to nautical men, deep sea cables, and electricians.

This looks first-class on paper, and will doubtless look a great deal better when 10 per cent. is paid from the first year's earnings. Now, the first thing which must strike anyone is this, that the Atlantic Telegraph Company must be very foolish in sticking to their present route—if what we have stated be correct; and yet, if we remember rightly, the old route is for the most part a long elevated plateau, "affording every facility for cable laying in general." We dare say there is more to be made public, when the latest new thing in telegraphy gets bruited abroad.

We may note, under this heading, that it is believed the covering wires of the new Atlantic Cable are to be galvanised, and that by a peculiar process of prestidigitation the said wires, though rendered weaker by the process, are to be fitted to stand a much greater strain than when minus the coating. How, we do not exactly see.

Passing from lines in embryo—not yet off the reel or coil—it is pleasant to notice that one line—the Electric and International Company—has just paid the highest dividend their Act of Parliament allows—ten per cent! In their Report the directors acknowledge that much of their success is due to those in the employment of the Company, and recommended the distribution of £4,394 among them, which has been done. After deducting this and the dividend from the profits there remained nearly £28,000 to be disposed of. How it was allotted it is not our intention to mention, but it is very pleasant to record such a fact as the above tangible "recognition." Such companies deserve to succeed; and if, instead of leaving their bounty a matter of speculation to the employed, during a long twelvemonths, it were divided over the year, we think the recipients would work even better, if possible. However, we do not cavil.

The time is drawing nigh for the next Atlantic venture: Spring will soon be here, and Summer follows rapidly on its heels, and thus, as the expedition will start earlier in the season, we are not too early in the field with our suggestion that everything be seen to in time—that the unfortunate donkey-engine be supplemented or supplanted, and generally everything got well forward and in a state of readiness for shipping the cable, about which, this time, there is to be no mistake. That there may be none is our sincere wish, as it is that of our readers; and we may add that we shall be pleased on some future day to record the success of Macintosh's system of ocean telegraphy.

DWELLINGS FOR THE PEOPLE.

IT is now some two or three Sessions since Lord Derby, in his place, called attention to the fearful lack of consideration shown by railway companies to such working folks as rent apartments by the week or month, when the sites of the houses occupied by the said working folks are required for the purposes of such companies. The "working man" has been a pet topic with more than his Lordship since that time—scarce a demagogue or caterer for his or "its" own good, *via* the working classes, but has thundered forth his or its denunciations against the selfishness of railway autocracy, &c., &c., in the matter of house room; and meanwhile, in the old-fashioned belief that Heaven helps those who help themselves, working folks have been paying into building and land societies, and getting their own houses or plots for houses by the tens of thousands—in London and throughout the provinces. Still there does exist an immense population very much at the mercy of those who care not who suffer so long as, under the guise of public necessity, their petty selfish ends are gratified. Amongst this class of *guizards* we class needy "promoters," and some attorneys and engineers anxious for loaves and fishes at anybody's expense but their own. The sufferings entailed on the truly "floating" population are very great, and some well-intentioned men have spoken up in their favour, and spoken well—the last we have to notice being Mr. Thomas Beggs, who a few evenings since read a paper at the Society of Arts on "Dwellings for the People—how to multiply them, and how to improve them," slightly noticed in our last

He proposes to effect this object by an extension and further development of building and of freehold land societies; to incorporate them under the Companies Act of 1862, giving them power to purchase land, build houses, or carry out any of the purposes for which they are embodied, on their giving the usual guarantees. He said it was desirable to grant these societies a more simple mode of conveyance and transfer, and the plan of the estate might be deposited in the office established under Lord Westbury's Act and so secure the title. Respecting London, the difficulty was the attainment of sites. To meet this he would seek for compulsory powers to obtain land for building purposes, as is done in the case of railway and dock companies. He would also seek for a power to enfranchise leasehold property under certain conditions, and a power to compel the sale of such property as may be in the hands of incapacitated persons, or where circumstances prove the inability of the owners to comply with the laws laid down for the protection of the public health. He would also ask that trustees of charitable and ecclesiastical institutions should be empowered to sell, exchange, or otherwise dispose of property tied up by trust, where such may be required for dwellings. And further that summary power should be given to the proper local authorities to remove from out of London prisons, workhouses, barracks, slaughter houses, cow houses, gas works, and all dangerous manufactories, and to place the sites at the disposal of public companies, who would undertake to build dwellings upon improved models. He also advocated the Scotch system of "flats," by which a man could purchase part of a large house having a common entrance, which works exceedingly well in Edinburgh, and, indeed, in all Scotch towns. Then spoke Mr. Walker, of Rugby, who "objected to making the very poor the owners of their own dwellings, as they would

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be sure to treat them as they did their own persons —keep them in a state of filth and dilapidation." He had built cottages in the country at £75, which answered very well as a commercial enterprise. Otherwise, Mr. Beggs' paper was very favourably received, and— the meeting adjourned. That is what it all came to. Now we should like to see Mr. Walker's "cottage for £75"—it must be a beauty at the money. How would it work in London, where it has been found impossible to build anything of a place for a man and his family under twice the money? Is Mr. Walker's a French *chateau!* — for it is the fashion, nowadays as formerly, with those who are utterly incompetent of themselves to originate an idea of the kind to fly either to France, Switzerland, or the Antipodes for what will do duty as such or serve as "stuffing." We fancy (but shall be happy to know to the contrary) that Mr. W. must have drawn upon an un-English source for his inspiration, and we can pity the unfortunates who are forced to contribute to such a "commercial success" as is based on an outlay of £75 nett. For our part we would be ashamed to mention or agitate such things. We do not advocate living in ventilated pigsties, even though they be provided with sunshades and mediæval chimney-pots. In the last number of the *Civil Engineer and Architect's Journal* are some excellent illustrations of the artisans' dwellings erected by Messrs. Paull and Ayliffe, of Manchester, at West Hill Park, Halifax, which are deserving of being more widely known than they now can be. One class of houses costs £160, and the other £270 each—land and contingent expenses included. They each consist of two floors, cellar, and back yard; the ground floor contains a living room and scullery, the yard containing the usual accommodations—the cellar entering from the scullery. The upper floor contains parents' bedroom, boys' bedroom, and girls' ditto, with closets or wardrobes. The planning and general treatment of both designs are very good—they are homely, handy, *English* houses, and reflect great credit on the architects.

Now, what we should advise being done in this matter—we have no un-English scheme to suggest—is simply the acquiring of compulsory powers of a certain kind, such as where a locality has been proven a pest—a fever haunt; powers to pull all such down and erect upon their sites solid, substantial houses—in flats if you like—for what answers in Scotland surely ought to answer here; or, where the suburbs are preferred, the purchase of land by societies, and the building thereon of houses on the plans of the architects above noted. Further, that Messrs. Paull and Ayliffe get up and sell at as low a cost as possible, plans and specifications of such houses, which could be erected in London at a figure not much exceeding that charged in Hailfax—when done by a company. We shall be happy to receive any corrections or suggestions on the matter—brief as possible, in fact only such can be noticed.

It is time, for the sake of the floating population, that something more be done: the getting of compulsory powers will be a step in the right direction, and this will afford such windy members of Parliament and their tag-rag as seem to have little else to expatiate on but the working man a chance of proving their sincerity—though we doubt their being the men to do it.

MELTING AND SMELTING.

(Illustrated on front page)

THE subject of iron engrosses so much of the attention of mechanical folks that we make no apology for introducing to their notice this week the improvements in melting and smelting furnaces made and patented by Messrs. Woodward, engineers, Queen's Foundry, Manchester. They are worth study, and consist, first, in arranging and combining furnaces for smelting ores and melting metals, so that air may be supplied thereto by the application of steam jets in the flues or chimneys leading from the furnaces, and by this means creating a partial vacuum above the fuel —the required air entering at orifices arranged in the lower part of the furnace. Second. In combining steam boilers with the furnaces—in one case the sides of the flues being formed of a hollow vessel or vessels, which act as steam boilers; the furnace heat getting up the steam, the waste of which is to act as a jet for the creation of a blast. Thus to do away with the furnaces, boilers, steam-engines, blowing cylinders, and centrifugal fans, used for supplying air to ordinary furnaces for melting metals or smelting ores. It will be seen that the patentees aim high; we will now see how the process is carried out.

The accompanying illustrations (Figs. 1 and 2) show the manner of applying the improvements to smelting furnaces, showing a combined furnace and boiler, according to the second part of the invention. In the lower part of the furnace there is one set of orifices, *c*, for the admission of air to the furnace, and a large chamber for hot air is formed round the base of the furnace, which is supplied by pipes. By the air-tight doors t^2 (Fig. 2), the lower part of the furnace may be got at when required, t^3 being dampers for shutting off the hot air from this compartment when the doors t^2 are opened. The upper part of the furnace is formed into a boiler, *m*, passing through which is the chimney, *g*, cased with firebrick after passing through the water-space. The boiler is supplied with necessary valves and gauges (Fig. 3). h^1 is the pipe for conveying steam from *m* to nozzle *h*, and k^1 are hoppers through which the furnace is supplied with the necessary material. These hoppers are supplied with doors, *k*, each closed by a balance weight.

The other figures show a combined boiler and smelting furnace according to this invention. This furnace is similar to that just described except that the boiler is formed of a series of boilers, *m* (Fig. 3), which are duplicates of each other, arranged so that one may be lifted from its place without disturbing the others, and whilst the furnace is in operation. There is a steampipe, h_3, encircling all the boilers, with which each boiler communicates by a pipe, h^4 (shown also in Fig. 6), there being a suitable stop-valve in each pipe. There is also a common pipe p^2, for feed water, with which each boiler is connected, each branch having a stopcock. Each boiler may have a Giffard's injector and a separate safety valve. In changing a boiler it is only necessary to disconnect the steam and water, and again connect them when the duplicate boiler has been located. The boilers may be lifted by a crane in connection with a jib arranged to turn round the chimney as a central pillar. The nozzle *h*, is supplied from the pipe h^3. The exterior of the cupola is formed of metal lined with firebrick in the usual manner.

ELECTRO-METALLURGY.

(Continued from page 228.)

As the sketches promised cannot be prepared in time for this publication, I will say a little on moulds to fill up the interval, and presume you have only the temporary battery given in the first lesson.

I know almost every student is anxious to try something grand, and it is not easy to convince him that difficulties lie in his way, but let all who take any interest in these simple chapters be content with humble objects at first—say a penny piece. Now, it will be evident on a moment's thought that if the type be taken direct by electricity from the coin it will be a negative copy, and that the negative would be employed to produce a positive or *fac simile* of the original coin, and if each took 48 hours, four days would be occupied, and much battery power consumed. While if the negative had been taken in wax or gutta percha, the positive would have been produced in half the time, with half the battery power. Let our readers try the three plans; they are all good in turn. When done, examine each positive, and there is little doubt the one obtained from the metal negative will be the most perfect; for it is quite an impossibility to take a negative in wax or percha as sharp in outline as by the battery process. Scratches and flaws exist more or less, but if the object to be copied is not required correct in minute particulars, percha and wax do well, and have the advantage of cheapness on their side.

The mode I have always found recommended for taking percha copies is to boil it in water till soft, roll it out and press upon the object. This looks very well on paper, and correct in theory, but I always found it clumsy and ineffectual, if not useless. I recommend from experience that gutta percha of any quality be cut into shavings, placed in a glass, and coal naphtha poured over till all covered. In a few hours this will be dissolved; stir it with any suitable tool to incorporate it well with the naphtha, and then add wood naphtha and stir. A short time after settling pour off all, the liquid, and the sediment keep in a well corked bottle for use. In using it, employ a camel-hair brush dipped in, and with it paint the coin one coat, shortly after with another, and then lay upon it a sheet of warm percha for strength, and when cold remove it. The impression will be much sharper than by the first process, and as it is nearly white instead of brown, the flaws can the more readily be seen.

The percha in solution may be kept almost any time in a well-corked wide-neck bottle, so that although it takes some time and care to make, is made once for, a long time.

Sealing-wax is very good for some patterns, but practice is required before a good mould can be made.

In taking moulds from articles that would not bear much pressure or would be injured by warm wax, sealing-wax or shellac pounded and mixed to a paste with wood naphtha, is a good substance. It should be kept in a jelly-pot, and air excluded, for use at any time.

White wax moulds are sometimes recommended, but I have always found them difficult to work with and uncertain, as the brushes are apt to get greasy, and they grease the plumbago.

MOMUS.

A NEW ANILINE BLACK.

M. Paraf describes a new method of producing aniline black, as follows:—I begin by preparing hydrofluosilicic acid by decomposing a mixture of fluor spar and sand with sulphuric acid. In an aqueous solution of this hydrofluosilicic acid of the gravity 8° Be. I dissolve hydrochlorate of aniline, and such a solution properly thickened and printed on a tissue prepared with chlorate of potash gives a black in the fixing.

The chlorate of potash may be combined with the above, and then the cloth needs no special preparation.

In fixing at 32° or 35° C., the following changes take place:—The hydrofluosilicic acid decomposes the chlorate of potash and forms fluosilicate of potash, setting free chloric acid. A part of the chloric acid acting on the hydrochloric acid of the hydrochlorate of aniline produces a mixture of free chlorine and some intermediate oxygen acids of chlorine, which, acting in concert with the other portion of the chloric acid on the aniline of the hydrochlorate, produces the black.

A chemist may convince himself of the truth of the opinion I advance by operating in the following way:—First prepare fluosilicate of aniline by dissolving aniline in hydrofluosilicic acid, using a gentle heat. As the solution cools a mass of splendid scales of fluosilicate of aniline will deposit. This salt is very soluble in water. By adding a solution of chlorate of potash to an aqueous solution of fluosilicate of aniline, a mixture of fluosilicate of potash and chlorate of aniline will be produced. This solution may be boiled without obtaining a trace of black; but if only a few drops of hydrochloric acid be added a black precipitate will be immediately formed.

The black obtained as above may be associated with any sort of madder colour, and in the subsequent processes may be treated exactly like a logwood black.—*Bulletin de la Societe Indust. de Mulhouse.*

STEEL MIXED CASTINGS.—Messrs. Turners, of Ipswich, cast their cylinders of portable engines from a mixture of cast iron and Bessemer steel.

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SPENCER'S IMPROVEMENTS IN REGULATING AND WORKING THE VALVES OF STEAM ENGINES.*

THE object of this invention is to economise steam, air, or gas as motive power, by introducing into more general use distinct and separate admission valves and improved escapement gear, and with such valves and gear materially to increase the speed of piston. The improvements consist, first, of an arrangement in which two spring plates or clips are connected at one end to a pin of a lever or wrist plate secured to a weigh shaft, such weigh shaft having a reciprocating motion produced by an eccentric; the other end of the spring plates or clips have inside projections which clip hold of or gear into other projections on a moveable block attached to the spindle or lever of the admission valve; and as usual in this class of escapement gear the closing of the admission valves takes place by the action of a trigger or toe, which, by its attachment to some fixed point, and by the motion of the eccentric and clips in opening the admission valves, releases or throws out of gear at the same moment both of the spring plates or clips, and the admission port is suddenly closed as usual by a spring or springs.

Secondly, in the introduction and application of two or more admission ports or passages in each end of the cylinders working with slide valves that are opened and closed with escapement gear; by this improvement the tripping gear described in the first part of this invention is rendered still more efficient, as the maximum movement of the valve spindles or levers may be much less than when one port is used as usual, and the less the motion of the valve splindles or levers the more certain is the action of the escapement gear, and the engines can be worked at an increased number of revolutions.

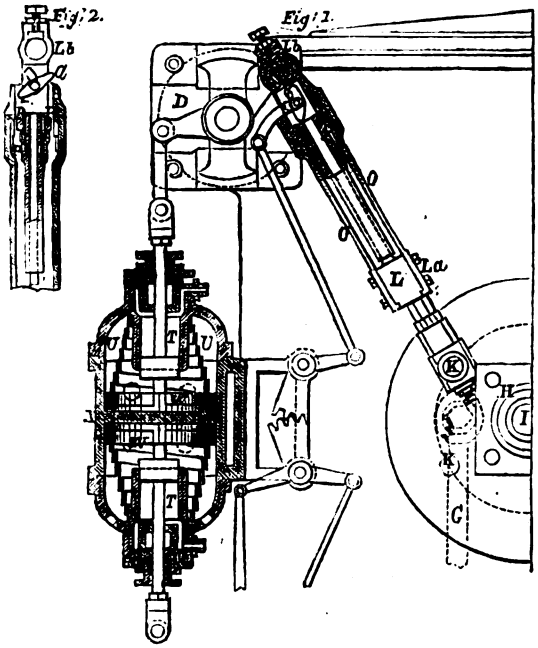
Thirdly, in attaching the piston of a small cylinder in which a pressure of steam, air, gas, or water is introduced to the spindle or lever of the admission valves, when worked by escapement gear, so that such valves are closed by such pressure instead of by the action of weights or springs.

Fourthly, in the arrangement of springs for closing the admission valves worked by escapement gear, the introduction of a spiral steel or india-rubber ring, or springs acting directly on the back of a piston used in a cylinder as an air cushion, to reduce the shock in the closing of the admission valves; it being usual to have such air piston, a dash pot, as it is termed, attached directly by a rod to the spindle or levers of the admission valves.

Fifthly, in forming one central chamber fixed midway to the cylinder or engine framing and arranged to contain the two air pistons and dash-pots, and the recoil springs; such chamber to be equally divided by a central diaphragm, and to have moveable ends or covers for ready access to the dash pot pistons and recoil springs of each admission valve.

Finally, with reference to the several parts of this invention, all having reference to improvements in escapement valve gear, it is to be understood, that to the cylinder of every engine there are two admission valves, two pairs of spring plates or clips, two dash pot pistons, and two springs or sets of springs for closing the admission valves when the escapement clips are disengaged or thrown out of gear by the action of the triggers or toes before referred to.

Fig. 1 is a side elevation, partly in section, of a part of a steam cylinder, sufficient to show the improvements in valve gear referred to, and fig. 2 is intended to show the improved escapement rod by itself; C is the cylinder of a steam engine, a portion only of which is shown, and such cylinder may be vertical, horizontal, or inclined, without impairing the usefulness of the improved valve gear; D is a portion of the valve chest, in which is one of the ordinary steam admission ports, and a plain slide valve made to cover the port with sufficient lap to prevent leakage and to suit the action of the valve. The port and slide faces may be flat or curved according to the plan adopted to move the valve. In fig. 1 the port and valve faces are curved; the slide valve is worked by drivers on a weigh shaft E, which might give motion to any other kind of valve, requiring little power to move it, but in the present illustration, a valve commonly called the "Corliss" valve is supposed to be used. G is a rod worked by an eccentric or crank on the main crank shaft, or on a supplementary shaft driven by the crank shaft, and the reciprocating motion of this rod causing the disc plate H, to vibrate on a pin I. On the disc plate are four pins K, K, two of which only are shown, and one of these gives motion to the escapement rod L, which is attached by a pin M, and lever N, to the weigh shaft E, which gives motion to the slide for admitting steam to the cylinder. The escapement rod consists of two principal and distinct parts La and Lb, one of which La, is always connected to the pin K, on the disc plate H, and the other Lb, to the pin M. O, O, are two spring clips bolted to that part of the escapement rod La, which is attached to the pin K, and these spring clips are connected to that part of the escapement rod Lb, which is attached to the pin M, by the grip of the projecting edges of hardened steel P, P; Q is a lever, toe piece, or trigger, working on the pin R, and connected by rods, &c., to an adjustable handle accessible to the engineer in charge. When the engine is started and the escapement rod is in gear, the motion of the disc plate and escapement rod in the direction of the arrows brings the trigger Q, in contact with the insides of the spring clips O, O, and throws them out of gear, and the admission valve is instantly closed by the action of a spring or weights acting on the lever S, and weigh shaft E, and the time when the clips are disengaged, and the admission valve is closed, can be varied at pleasure by the relative position of the trigger lever, which is held in any position at the pleasure of the engineer in charge, or the trigger may be connected to a governor to regulate the speed of the engines, by varying the amount of the steam admitted to the engines. The two parts of the escapement rod before described are shown, as guided in the same line of motion by a guide rod and bush.



In fig. 2 the escapement rod is shown disengaged, the steel spring clips being pressed outwards by the pressure of the toe or trigger, and allowing the parts La and Lb of the escapement rod to be separated by the closing action of the slide valve. Escapement valve gear, such as is used in pumping engines, is so well known to engineers that any further description of the first part of the invention is considered unnecessary.

The second part of the invention is limited to cylinders working with slide valves only.

In explanation of the third, fourth and fifth portions of the invention, the piston and cylinder in which the pressure of air, steam, gas, or water is used to act on the lever S, and close the admission valves, is shown at T, and these cylinders (one to each admission valve) may be supplied with steam, air, &c., from any convenient source.

To illustrate the improvements in the springs and air pistons for effecting certainly, and yet gently, the closing of the admission valves, a volute or spiral spring is shown at U, U; W is the air piston, X is the central chamber, and Y is the central diaphragm.

* From *Newton's London Journal of Arts.*

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The Thirteenth Anniversary Dinner of members and friends of this benevolent and scientific institution is appointed to take place at the Freemason's Tavern, on Saturday next, the 17th inst., at 6 p.m. John R. Ravenhill, Esq., C.E., will preside, and will be supported on the occasion by Joseph D. A. Samuda, Esq., M.P., E. J. Reed, Esq., Vice-President of the Institution of Naval Architects, and Chief Constructor of the Navy; Captain Andrew Clarke, R.E.; Edward Humphreys, Esq., and many other gentlemen of scientific eminence. Cards of admission (7s. 6d. each) may be obtained, up to Friday next, of Mr. Thomas Sanson, 38, East-street, Manchester-square, W.

PROGRESS OF INVENTION.

SAWING STONE.—A new apparatus has been introduced into Paris for sawing stone. Instead of the saw ordinarily employed, a disc of lead, kept well covered with emery, is used. The lead is cast on a circular plate of cast iron, of sufficient thickness and diameter, and pierced with holes, which, by means of the lead with which they become filled in the casting, unite together strongly the thin sheets of lead at its two sides, which are joined also at the circumference of the disc. The emery falls from a reservoir above the disc, and the surplus is conveyed into a trough underneath, whence it is brought back to the vessel which feeds the disc. This apparatus is either moved on a carriage to the rock which is to be cut, or the block of stone is brought up to it on a carriage. A saw of this description, about 3ft. 6in. in diameter, driven by a 4-horse power engine, was found to move through Carrara marble at the rate of about 2¼ inches per minute, and through Normandy granite at the rate of nearly an inch in the same time; and the cost of cutting was scarcely the one-sixth of that by the ordinary method.

DESULPHURISING COAL.—Mr. Charles F. Dennet, who for 12 years was the active agent of Colt's Fire-arms Factory Company in this country, is about introducing a new method for the treatment of coal, which has been pronounced a decided success. The coal prepared by the new process, which is very simple and cheap, is said to be far superior to coke for melting iron, &c. A much hotter fire can be made with it than with coke. Cast-steel heated by coal thus treated has been welded without the use of borax or other ingredients. Pig-iron, which has been proved too hard, has been found to yield and produce as good work as turned out with some of the best brands of iron.

IRON CEMENT.—A new cement, in which iron forms an important constituent, has been invented in France. It is formed by pulverising iron sponge, and mixing the powder with fine sand, which has been slightly acidulated, and water. The result is a paste, or mortar, which is capable of firmly uniting pebbles, &c., into a perfectly solid mass, forming pudding-stone, conglomerates, breccias, &c., of any desired variety of colour, and great durability. This cement may also be moulded into statues, bas-reliefs, public fountains, &c., and may be used as a substitute for cut stone; and large masses of material, such as church spires, can be so united by it as, practically, to form monoliths of great strength. It is impervious to moisture, which greatly enlarges the sphere of its utility. The finely-divided iron is oxidised, water being decomposed and hydrogen set free; and the silex of the sand forms, with the oxide, silicate of iron, a material of great tenacity, not affected by the temperature of boiling water, by atmospheric changes, nor by acid or alkaline liquids.

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SAW TOOTH.

This engraving represents a plan, suggested by Mr. J. E. Emerson, of Trenton, N.J., America, for securing false teeth in circular saws—called false teeth in distinction to those worked solid on the saw, in the usual manner. It is not claimed that the idea of so fastening teeth in saws is novel, but that the plan itself is a valuable improvement. It will be seen, on examining the engraving, that the tooth A, is curved in form, and that it is grooved on the back, as at B. In this shape it is fitted to its seat in the saw, which is adapted to receive it, as will be perceive on inspection. When once placed it is fastened by a rivet, C, one half of which is in the tooth, and the other half in the saw, where it is firmly held. It is claimed that this method of construction prevents the teeth from ever becoming loose, for the reason that the action of them on the wood being sawed tends to bind them firmly in place, and that the greater the resistance the stiffer they become. The bevelled edge of the seat on the saw prevents the tooth from slipping sidewise, as may be seen. It is also claimed that the teeth are easier to fit in place than by some other methods, and do not injure the saw itself by buckling or expanding it, as is done when the teeth are driven in forcibly. The concave side of the teeth are made thicker than the opposite, or convex side, forming, as the inventor says, a dust chamber, so that no sawdust is allowed to pass the tooth and clog or pack against the timber and heat the saw when in use, but is all carried through the timber and discharged below. The inventor claims for his improvement the following advantages:—The teeth are forged from the best cast steel, and therefore are better material than the saw plates; they can be removed and new ones inserted very readily; they increase the size of the saw; they require no setting, and run with less power than common teeth, and can be more easily kept in order: the liability of breaking and springing or straining the saw by gumming is avoided, as these teeth are not so treated; only one half the number of teeth are required, and these cut smoother and are not so liable to heat when in use as the ordinary one.—*Scientific American.*

SUBMARINE TELEGRAPHY.*

THE INSULATED CONDUCTOR AND ITS PROPERTIES.

The lecturer stated that in the lectures he was about to deliver he should aim rather at spreading more widely the knowledge possessed by those practically acquainted with submarine telegraphy, than at announcing the latest discoveries or most novel theories.

1. *Terms Used:—Conductor, Insulator, Battery, Earth, Circuit, Current.*—Some elementary explanations were given with the view of explaining these terms. The action of a current on a magnetic needle, the simplest form of galvanometer and electromagnet, were shown with their application to practical telegraphy. The two sources of failure, viz., want of continuity in the conductor, and want of insulation forming a short circuit, were explained. The reflecting galvanometer was exhibited as a means of indicating a feeble current.

The following is a more detailed abstract of the rest of the lecture:—

2. *Component Parts of Submarine Cable.*—These are, 1st, the conducting wire, generally formed of copper; 2nd, the insulator, surrounding the conductor, generally gutta-percha or india-rubber; 3rd, the outer covering, intended to give strength, and generally formed of a hempen serving, surrounded by iron wires, laid as in a rope round and round the core.

3. *Conductor.*—(*a.*) *Mechanical Properties.*—The conductor is almost universally made of copper, but a solid copper wire is apt to be brittle, breaking after being bent a few times; interruptions occurred from this cause in early cables: this defect is wholly removed by the use of a strand of several wires, generally three or seven. The tensile strength of copper wire is in some books given as 60,000 lbs. per square inch. That used for submarine cables, being selected for electrical rather than mechanical qualities, will only bear from 35,000 lbs. to 39,000 lbs. per square inch. Copper stretches so much (10, 11, 12, or 15 per cent.) before breaking that its full strength can seldom be made use of. This extensibility is, as will be seen, a very valuable property, preventing the interruption of the circuit until the strengthening part of the cable be fairly broken. The following are convenient approximate formulæ:—A copper strand will bear $1\frac{1}{2}$ lbs. per pound weight per knot before breaking; it will stretch one per cent. with 1 lb., and will not stretch at all with 0·75 lb. per pound per knot; thus a strand weighing three hundred pounds per knot will barely support 450 lbs., will stretch one per cent. with 300 lbs., and will not stretch at all with 225lbs. The weight of copper in lbs. per knot can be calculated from the diameter d in inches by the use of the following constants:—weight = 18,500 d^2 for solid wire, or 15,100 d^2 for strand. The joint of the conductor is made with great care: a scarf joint is made by soldering together two filed and fitted ends; this joint is wrapped round with fine copper wire to give it strength, and solder is again run round this wire; a second wrapping of fine copper is then applied, and left without solder. The joint is necessarily less extensible than the rest of the strand; if forcibly torn asunder, the last wrapping of copper maintains the electrical connexion, being simply pulled out like a spiral spring. No interruption from breakage at joints has ever occurred since this system was adopted.

(*b.*) *General Electrical Properties.*—Copper is what is called a good conductor, offering small resistance to the passage of the electric current; that is to say, a much less powerful current would be sent by any given battery through a long iron or lead wire than through a copper wire of equal length and diameter. Table I. gives the relative electrical resistance of several substances compiled from Dr. Matthiessen's experiments. The lower the number the better the conductor.

TABLE I.

Relative resistance of materials O° C. Wires of equal length and diameter.

PART I.—CONDUCTORS.

Silver, Hard	1·00
Copper ,,	1·00
Gold ,,	1 28
Iron	5·94
Tin	8·09
Lead	12 02
Brass	4 50
Gold silver alloy	6·65
German Silver	12·82
Platinum Silver alloy	14·93
Mercury	58·15

PART II.—INSULATORS.

Gutta-Percha at 75° Fahrenheit 60,000,000,000,000,000,000	or 6×10^{19}
Glass not less than 600,000,000,000,000,000,000,000,000	or 6×10^{26}

Conduction takes place through the mass, and not along the surface of the wire. A strand and solid wire of equal weights are equally good conductors; but owing to what is termed lateral induction, to be hereafter explained, the strand is at a slight disadvantage for rapid speaking through long submarine cables. Messrs. Bright and Clark, to avoid this defect, used in the Persian Gulf cable a segmental strand, built up of six wires fitting one another and drawn through a tube; they hoped thus to combine the advantages of the strand with those of the solid wire. Mr. Thomas Allan surrounds his copper conductor with fine steel wires, to give strength and avoid the use of heavy external protection. In a sample given to the lecturer, the resistance of the conductor so formed was about 30 per cent. more than that of a simple copper conductor of equal weight. Taking induction into account, Mr. Allan's cable would be about 50 per cent. inferior in speaking power to a cable with simple copper conductor of equal weight, and covered with an equal amount of insulating material. This inferiority is not a fatal defect if the cost of the outer protection is avoided. The general merits or defects of this plan will be spoken of in a future lecture; although the danger of decay where iron and copper meet is known, Mr. Allan's proposal deserves serious consideration.

(*c.*) *Chemical Properties of Copper Wire.*—A current flowing from the copper end or pole of the battery through a hole in the insulator to the sea, causes the formation of chloride of copper, a soluble salt. The copper is thus gradually eaten away, until metallic continuity is interrupted, and the cable ceases to transmit messages. The current from the zinc pole does not produce this effect, but only a deposit of soda in the fault, which, however, then allows a greater leakage, tending to enlarge the hole in the gutta-percha. Mr. C. F. Varley has proposed to twist up a fine platinum wire with the copper strand of long cables. This wire would maintain the communication at any point where the copper might be eaten away.

4. *Insulator.*—(*a.*) *Gutta Percha and Chatterton's Compound.*—Gutta-percha is pressed out, while warm and plastic, through a die round the conductor; several successive coatings or tubes are thus applied, till the desired thickness is obtained. The first coating is attached to the strand by a substance known as Chatterton's compound, which is also used between each layer of gutta-percha, and between the separate wires of the strand, to prevent the percolation of water along the interstices, in case any part of the copper should be accidentally immersed in the water.

(*b.*) *Mechanical Properties.*—Gutta percha has considerable tensile strength, bearing about 3,500 lbs. per square inch of section, but, owing to its great extensibility, it does not add more than about one-third of its whole strength to the copper strand. Roughly, it may be said to add in small wires 20 per cent. and in larger cases 30, 40, or even 50 per cent. to the strength of the copper strand; it will stretch 50 or 60 per cent. or more without breaking, but almost always fails as soon as the copper inside gives way. It will bear ill-usage, such as knotting, squeezing, or stretching, without injury, but can be pierced with a sharp instrument or cut by a knife without much difficulty. Uniform pressure, such as it sustains under water, improves its electrical qualities, augmenting its insulation resistance, according to Mr. Siemens' experiments, about 60 per cent., at 24° C, for every ton pressure per square inch, corresponding nearly to 1,000 fathoms depth of water. It becomes soft at about 100° Fahrenheit, and should, after manufacture, never be heated beyond 90°. The joints required are made by heating the two ends of the covered conductors after the copper is joined, and applying by hand successive coatings of warmed and plastic gutta percha. The separate layers of gutta percha are also cemented by Chatterton's compound; thus the joint is, when sound, very similar to the rest of the core. Extreme cleanliness and much skill are required in making these joints.

Some years since joints frequently failed, not always when just made, but after some months,

* Lecture I.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, January 29.

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becoming hard and brittle, and shrinking, so as to leave a gap between the old and new materials. The process is now thoroughly understood, and is a safe one in skilled hands, but in skilled hands only.

(*c.*) *India-rubber.*—This material is applied in many ways; most commonly tapes of masticated or bottle rubber are wrapped round and round the conductor until the required thickness is reached. At first these tapes were, as it might be termed, gummed together with solvents, but these caused decay, and have been abandoned; heat is now the common agent for effecting the adhesion. Mr. Siemens, who applied his tapes longitudinally, like two long half-tubes, used simple pressure to join the two halves together. He employed most ingenious machinery to cut the tapes the instant before they were applied to the copper, as the material only reunites if quite freshly cut; several successive coatings could be applied in this way at one operation. Some manufacturers considered that none of these methods were fully successful, and vulcanized the india-rubber, converting it into various materials of different degrees of flexibility according to the process employed. This material was also criticised, and Mr. Hooper has covered conductors with pure india-rubber next the copper, followed by a coating of oxide of zinc and rubber, and enclosed by a vulcanised jacket. In the process of baking the core to vulcanise the jacket, a little sulphur penetrates the india-rubber and the whole mass becomes remarkably compact and durable. Mr. Hooper heats the core to 250° Fahrenheit, and bakes it for four hours. The mechanical properties of these different materials vary greatly; they are all, however, very extensible, and do not add sensibly to the tensile strength of the conductor; they will bear considerable ill-usage, but are mostly softer than gutta-percha, and the pure rubber will not bear continued pressure even by a blunt surface but gradually yields. The joints in each form are now made so as to imitate as far as possible the main core. Mr. Hooper bakes his joints two hours in a steam jacket.

(*d.*) *Chemical Properties and Permanency.*—When dry and exposed to light, gutta percha becomes dry and brittle, losing all its valuable qualities, and is said to be oxidized. Under the same circumstances the various forms of india-rubber decay in various ways; some become treacly, some brittle, some almost friable. Mr. Hooper's hard covered seems to last best of all in air. When in water gutta percha is, so far as fifteen years' experience can show, absolutely permanent. Many thousands of miles have been laid down, and many hundreds of miles picked up after lying in the sea in various parts of the world, in deep and shallow waters, for many years and not one single yard of material has been found which had under those circumstances decayed or lost its insulating properties. The importance of this fact cannot be over estimated. The experience as to india-rubber is the very opposite to this; little has been employed, and a great deal of that little has been found to decay, so as to be utterly useless. No doubt improvements are continually introduced, and possibly some of the forms now made may answer better, but till the subject is more thoroughly understood it would be lost time to reproduce all the theories by which the various failures are explained. Out of five specimens supplied lately to the Indian Government, one only, Mr. Hooper's, proved durable even for a year. The lecturer's own experience confirmed this experiment. It must in justice be said, that considerable lengths of india-rubber covered wire are successfully used on land, supplied by Messrs. Silver and their descendant the India-rubber and Gutta-percha Telegraph Construction Company, and by Messrs. Wells and Hall. The Indian Government has ordered about 100 miles of wire covered by Mr. Hooper's material, which will, therefore, now be subjected to a thorough practical test. India-rubber stands heat much better than gutta percha.

(*e.*) *General Electrical Properties.*—Gutta percha is a very good insulator; all insulators conduct a little, but the figure written after gutta percha in table I. will show the relative resistance to conduction with equal bulks of copper and gutta percha. A better idea of the vastness of the number will be obtained by observing that light would take a century to travel through the number of feet which that number would express. The practical result of this degree of insulation with the Atlantic core is that more than 99½ per cent. of the current leaving England would reach America if the cable were but laid; any improvement in insulation will, therefore, only go to diminish this half per cent. loss, in itself of no consequence whatever. India-rubber has a higher resistance still; the chief advantage to be obtained from this high resistance is the facility it gives for detecting faults. India rubber is, however, superior to gutta percha in another electrical property, called its inductive capacity. More words per minute, in the proportion of 4 to 3 at least, could be sent through an Atlantic or other long cable insulated with India rubber than if insulated with gutta percha, the weight of insulator and conductor remaining the same. This point will be more definitely treated of hereafter.

(*f.*) *Absorption of Water.*—Mr. Fairbairn long since stated the superiority of gutta percha to india rubber for deep sea cables, owing to the comparatively small quantity of water which it absorbs. Probably the never forms of india rubber may have improved in this respect, but Mr. Siemens found that pure india rubber absorbed 25 per cent. vulcanised rubber 10 per cent., and gutta percha 1½ per cent. of their weight in pure water; these quantities were reduced to 3, 2·9, and 1 per cent. respectively in salt water. The absorption continued for three hundred days—it was eight times greater for india rubber at 120 deg. of Fahrenheit than at 39 deg., but for gutta percha it was only doubled by the rise in temperature. Mr. Siemens considered that pressure affected the absorption very little. The amount absorbed by gutta perch in no way damages it. This is proved by thousands of miles of submerged cables; for instance—the tests of the Malta Alexandria cable, laid four years since, under Mr. Forde's superintendence, by Messrs. Glass and Elliot. Part of this cable supports about half a ton per square inch pressure.

5. *Mechanical Properties of Completed Core.*—Few persons are aware of the great strength of the common gutta percha covered wire. An experiment was shown by the lecturer, in which 5 cwt. was hung from the slender looking core of the New Atlantic cable; it stretched some ten per cent. under this weight, and was then taken down, knotted, squeezed, and cut open, when the copper conductor appeared quite undisturbed in the centre of the gutta percha, which exhibited no trace of injury. Before the application of Chatterton's compound, the wire was liable to start out of the cable after it had been stretched and cut, or softened, owing to the unequal elasticity of copper and gutta percha, but with Chatterton's compound considerable force must be used to drag out the copper wire, even when the core has been stretched and is cut open. Table II. shows the strains which various wires can support.

TABLE II.

——	No stretch.	One per cent. stretch.	Breaking strain.
	lbs.	lbs.	lbs.
Atlantic core	340	414	660
No. 14 copper covered to No. 1, 107 lbs. copper, 166 lbs. gutta percha	134	162	218
No. 16 copper covered to No. 4, 73 lbs. copper, 93 lbs. gutta percha	100	120	150

Table III. gives the dimensions of the cores in some of the most important cables laid. It is noteworthy that 300 miles of the very smallest core practically in use, laid without any outer protection whatever, maintained our connection with the army for nine months during the Crimean war.

TABLE III.
Dimensions of Cores of important les.

Name of Cable.	Copper Conductor. Total weight in lbs. per knot.	Copper Conductor. Total diameter of conductor = d.	Gutta percha. Weight in lbs. per knot.	Gutta percha. Diameter in inches = D.	Approximate Ratio $\frac{D}{d}$	$\frac{D}{d}$ Log e $\frac{D}{d}$
Red Sea Cable	180	0·105	212	0·34	3 4	1·224
Malta Alexandria Standard	400	0·162	400	0·457	2·95	1·082
Persian Gulf	225	0·109	275	0·38	3·48	1·249
First Atlantic	107	0·083	260	0·38	4·8	1 57
Second Atlantic	300	0·144	400	0·464	3·28	1·19
England and Holland	143	0·095	223	0·34	3 47	1.244
Toulon and Algiers.	107	0·083	223	0·34	4 26	1·45
Varna, Balaclava	73	0·062	166	0 3	4 84	1·58

SCIENTIFIC NEWS.

THE FISH-TAIL RUDDER.—Dr. McGrigor Croft's fish-tail rudder, consisting of diagonal curved blades, attached to the upper surface, on either side of an ordinary rudder, has been found, on trial, to give very satisfactory results, and is now being fitted to a number of vessels. Any improvement calculated to afford a more complete control over the ship, and facilitate steering, particularly when easily applied to the ordinary rudder, is worthy of earnest attention.

Mr. THOMAS DAVIDSON, F.R.S., F.G.S. of Brighton, has been elected an Associate of the Belgian Academy of Sciences.

PHYSICAL methods may, in some cases, be employed advantageously in determining the chemical composition of bodies. The specific gravity, boiling point, amount of expansion by heat, and even the capillarity of a fluid have been suggested as furnishing useful results. A recent number of Poggendorff's *Annalen* contains a paper by M. E. Reichert, on the different refractive powers of fluids as influenced by their varying chemical composition. His paper contains the results of experiments on solutions of common salt, of different strengths. The percentages of salt, as indicated by the optical method and by ordinary analysis, appear to agree very closely. The first column of the following table shows the percentages as obtained by analysis, and the second gives the results of the optical method:—

2·26	2·27
7·12	7·13
12·02	12·07
17·25	17. 25
23·02	22·89

An equally satisfactory result was obtained with solutions of sugar, but with alcohol and acetic acid the differences in the refractive indices are only about half as great, and the indications were therefore not so satisfactory.

APPLICATION OF THE ANILINE DYES TO PAINTING.—It is found that all resins having acid properties—caoutchouc and the aniline dye-stuffs—dissolve in the solution of aniline. Shellac is thoroughly soluble in it, and the resulting solution may be coloured with the concentrated solution of an aniline dye-stuff, the result being an excellent material for producing transparent paintings on glass, porcelain, &c., to which it very firmly adheres. The aniline dye stuff may be dissolved directly in the aniline solution of shellac, with the aid of heat; but not fuchsine, since this, when heated with shellac, is changed to blue: hence, when this substance is to be dissolved, a solution of it in aniline, prepared without heat, is to be mixed with the aniline solution of shellac. These shellac solutions of the dyes may be mixed with oil paint not containing lead, and thus a brilliancy of tone may be imparted to the various colours in oil which they do not themselves possess.—*Scientific Review.*

STEEL RAILWAY CARRIAGES.—Railway carriages largely constructed of steel are to be made for the Mont Cenis Railway, and carriages of like construction are to be introduced upon one or two of the Indian lines.

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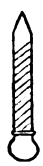
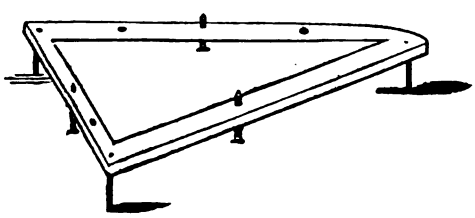
PRACTICAL PHOTOGRAPHY.

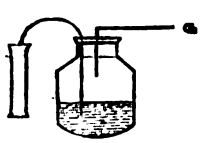
VII.

Positive pictures may satisfy for a time but the advantages of negative for the multiplication of copies is self evident. In proceeding therefore to intensify the picture with this object in view, observe the difference of deposit thrown down by the iron and the pyrogallic intensifiers. The former will keep well, the latter only a week or so. It is better therefore to make only a few ounces of the pyrogallic mixture. The silver solution may be made of any strength, *e. g.*, if you require, say 2 drms. of the iron intensifier, and add to it 1 drm. of silver solution containing 20 grains to the ounce of water; half the quantity only, or even less, will be required with a 40 grain, or a solution in proportion. Some amateurs, to save trouble, take a few drops out of the bath with the dipper. As soon as you have finished with the measure or glass you have been using for this purpose, fill it with water, and be careful to have it quite clean before using again or you may injure the beauty of your next picture. You may require to lay your plate down at some stage of manipulation, and then the want of a stand will be evident. The simplest form may be readily made by any village blacksmith, a piece of cardboard cut to the size you require with dots or punctures where the joints or screw holes should come will make your desire the more readily understood. For a quarter-plate glass, say, 3 strips of metal ¼in. thick, and ¼in. wide, weilded at the corners into an equilateral triangle, the dotted holes are all the same size and thread, have 3 or 4 screws to fit, something of this sort pointed. At the corners fit in 3 legs of 2 or 3 inches in length of fine rod, thickness of a lead pencil. The place for the screw holes may be easily adjusted by laying a plate of glass on the framework, and boring accordingly. The stand will then be of this form.





You may possibly require a collodion apparatus for drawing off the upper portion of the liquid and leaving the sediment; if so you may do it thus—a wide mouthed 4-ounce bottle and two pieces of glass tubing, having a bore of about 1-6th inch diameter, bend to the shape either with a blowpipe or in a clear fire; pierce a cork for the tubing and see that it fits the neck of the bottle nicely. Pour in the collodion over night to let it settle, cork it well the next day, remove the stopper and insert the tubing and draw off by gently blowing through the tube at *a*. Various remedies have been recommended for throwing down dust, &c., such as a drop of water or a drop or two of chloroform; but the better plan appears to be to mix as you require, noting that uniodized collodion, if so kept for any time, may become acid, and "contra" when mixed loses its sensitiveness from the free iodine disengaged. If when fixing you find that the iodide is not all dissolved out do not drop the cyanide on the remaining spot to cleanse the picture, but pour over the whole plate again; otherwise the part just touched will be weaker than the rest, but the first application of cyanide should be once and for all, letting it remain till the process is effected. It will not take very much practice to understand whether a picture, on being developed, is worth varnishing, for this is a matter of consideration, both with regard to the cost and the trouble required after varnishing to get the plate clean for another picture. Heat the plate gently and moderately; varnish if applied cold leaves a waxy white opaque appearance, spoiling the picture. If the picture is not a good one, place the plate carefully in a basin of water to keep the film wet, but do not let the corner of one plate scrape on the surface of another or scratches will be formed. Plodder.



ASTRONOMICAL NOTES.

Newly Recognised Force disturbing the Moon.—M. Delaunay has in *Comptes Rendus*, No. 24, 1865, an elaborate paper on this subject. His conclusion is that the "perturbing forces to which are due the periodical oscillations" of the surface of the sea (the tides) in "exerting a heaping-up effect in the water, determine a progressive retardation in terrestrial rotation, and produce also an apparent sensible acceleration in the mean movement of the moon."

Mr. T. Fletcher, of the Tarnbank Observatory, has drawn the attention of those astronomers who are in possession of large telescopes, to the present condition of that most remarkable star, *Herculis*. With his large refractor of 9½ inches aperture and a power of 1,000 it is absolutely single. A few years ago, he had no difficulty in measuring it both in position and distance with a telescope of 4 in. aperture only. As the companion star is undoubtedly close upon its perihelion, the earliest possible observation of its reappearance will be of great value in the determination of its orbital element. Mr. Dawes states that last year he found the star quite single.

The Royal Museum at Florence, the labours of which in promoting science have been more than once interrupted by political troubles, has taken a fresh start—a fact which will be highly gratifying to physicists and naturalists all over Europe. The appearance of the first volume of a new series of "Annali del R. Museo di Fisica e Storia Naturale" is of such a character as to inspire the hope that there will be no more interruptions. It is quarto in form, with well executed plates, containing papers by Donati on the bands of stellar spectra; on the eclipse of 1860; comet observations from 1854 to 1860; papers by Prof. Magrini on chemical and electrical subjects, among which results of new experimental researches in electro-magnetism and dia-magnetism will be consulted with interest. Besides these the volume contains botanical, palæontological and natural history papers by Cocchi, Parlatore, Caruel, and Benvenuti, names of well-established repute. The plates of the eclipse, printed in colours, are not less effective than instructive.

HONOUR TO WHOM HONOUR IS DUE.

Some few weeks since we called attention to a work of art then exhibiting at the Anglo-French Exhibition, viz.—a wrought-iron bracket, for which a silver medal was obtained by the exhibitor and artizan, Mr. Letheren. We have now great pleasure in announcing that Mr. Letheren, foreman of the Landsdown Iron Works, Cheltenham, has gained the first prize (£7 10s.) for a similar work of art at the Society of Arts Exhibition, and also that the bracket has been purchased by Government for the South Kensington Museum. According to the rules of the Society, the works for which prizes are awarded are strictly laid down. For the one we speak of the conditions were "for a piece of wrought ironwork of the 16th century adapted for a bracket." For those living in London and wishing to compete, it was easy to go to South Kensington and see the original, but for those in the provinces photographs were forwarded; it is easy to see the difficulties Mr. Letheren had to contend with, and only fair he should receive the honour so justly awarded.

The project of a German North Polar Expedition is in a fair way of being carried out, the Prussian Government having placed a ship, the "Medina," a corvette of 200-horse power, at its disposal, and the sum of 60,000 thalers as a contribution towards the outfitting expenses.

CHEMICAL NOTES.

The New Anæsthetic.—Bichloride of carbon, or as it is now being called, chlorocarbon, is an anæsthetic differing from chloroform, by the substitution of one atom of chlorine for the single atom of hydrogen in the formula for chloroform. Thus, while the latter is C_2HCl_3, chlorocarbon is C_2ClCl_3. Chlorocarbon has much the same appearance and taste as chloroform, but it is of greater specific gravity, and has a higher boiling point. It is taking its place in surgery.

Cheap Mode of Producing Oxygen.—The ordinary methods of obtaining oxygen are attended with so much expense that chemists will gladly learn that a new method for the production of this gas upon a large scale has been spoken of. Indeed a company has been started in Paris for the purpose of supplying oxygen at the rate of about threepence per cubic foot, which is hardly a fiftieth of the present cost. The oxygen is obtained by acting on sulphate of lime with silex in a furnace of peculiar construction, the results being silicate of lime, sulphurous acid and oxygen—

$$Si_2O_3 + CaO,SO^2 = CaO,SiO_3 + SO_2 + O$$

The gaseous mixture is conducted into a chamber, where it is exposed to a pressure of three atmospheres, which liquefies the sulphurous acid; the oxygen is purified by transmission through lime-water, and then compressed.

Manufacture of Arsenic Acid.—M. Gerardin's method consists in suspending powdered arsenious acid in water, and passing chlorine into the mixture, by which means he obtains a clear solution of arsenic acid in solution in hydrochloric acid. By evaporating this solution, a mass of arsenic acid containing no trace of arsenious is procured. As it is difficult to keep any considerable amount of arsenious acid in suspension in water, the author finds it better to make a saturated solution of that acid in hydrochloric, and pass the chlorine into such solution while hot. The stream of chlorine is stopped when a little of the fluid neutralized with potash no longer gives a green precipitate with bichromate of potash; thus showing that all the arsenious acid has been converted. The hydrochloric acid may then be recovered by distillation, and the syrupy solution of arsenic acid left in the retort evaporated.—Vide *Chemical News*

PHOTOGRAPHIC NOTES.

The Alleged Early Photographs.—The *Times*, reviewing Mr. Smiles' Lives of Boulton and Watt, remarks on the subject: "It has been suggested that the question of photography was a matter of discussion at the monthly meetings of the Society, and the discovery of a photograph in Mr. Boulton's library at Soho, which it was asserted had not been opened for about fifty years, gave rise to the rumour that some of its members had actuylly practised the art at that early date. The plate is still in the possession of Mr. Petitt Smith, of the Patent Office Museum, but there seems to be little doubt it is of modern production. The "Lunatics,', as they were called, did not hide their lights under a bushel, as we well know from the dispute among its members as to the question of the discoverer of the composition of water, and not one word with reference to theart is to be found in any of their familiar letters to each other.'

The New Developer.—Mr. G. H. Martyn, of Plymouth, sends us (*Photographic News*) some charming cards af illustrative of the action of the new developer, the solution he employs being a mixture of the ordinary protosulphate developer with a little of a preparation analagous to that proposed by Mr. Carey Lea. It consists common glue 1 ounce, sulphuric acid 1 ounce, water to make up to 5 ounces; in this solution on wire is placed and left for 4 or 5 days, so as to saturate it. Then five ounces of water are added, and acetate of lead to neutralize any free sulpheric acid. One daachm of this, afteo filtration, is added to an ounce of a 30-grain solution of protosulphate of iron. The pictures are admirable, round, delicate, vigourous, and of excellent texture.

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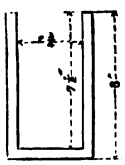
THE ATMOSPHERIC INSULATOR.

VARIOUS correspondents have sought from us, from time to time, some information concerning the insulator for boilers, steampipes, cylinders, &c., of the Messrs. Bevan and Fleming, York-buildings, Liverpool. Having placed ourselves in communication with these gentlemen we have received the following information from them, which we have supplemented by illustrations, so as to make the information as clear as possible.

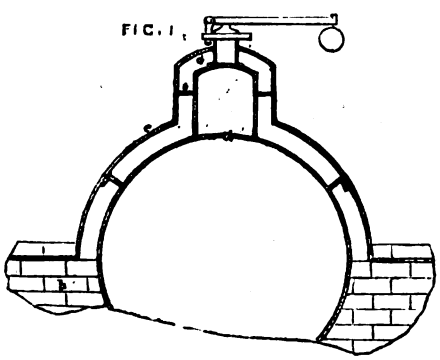
The means hitherto practised to prevent radiation, and consequent loss of power from the surface of cylinders, pipes, and boilers, have been carried on under the impression that they must of necessity be covered with some material or substance. "We," say our correspondents, "had reason to doubt the correctness of this theory, and by a series of carefully tested thermometrical experiments have established the fact that by the application of any material or substance . . . to these external surfaces the object is defeated more or less according to the nature of the material used. Each of the substances now in general use act as conductors and absorbers of heat, according to their density or porosity: thus, sand is a superior non-conductor of heat than clay, sawdust than wood, iron-filings than iron, charcoal than ashes, &c.: in short, the more any body is permeated by the atmosphere the better non-conductor of heat it becomes. Upon these facts we have patented our process of insulation by gas or atmospheric air alone or combined. In long lengths of steam-piping—necessitated by the distance between boiler and engine—we find our insulator effects a saving of several pounds pressure. . . The difference in consumption in coal between naked piping and cylinders, and those with the atmospheric insulator we proved by experiments extending over several days. With the naked cylinders, &c., there was a consumption of 1 ton 17 cwt. (from 6 a.m. to 6 p.m.), with the insulator the consumption was reduced to 1 ton 4 cwt. 2 lb., or a difference of a third. Here is the result of an experiment made with three tin tubes, 2¾ inches diameter by 7½ inches, one surrounded by an air jacket by means of another tube, 6-10ths in. diameter, and ½ inch longer, closed at ends, as in figure, another tube, size of inside one, covered with a so-called conducting composition; the remaining tube same size, viz., 2¾ in. by 7½ in. The tubes were filled with water at 212°, and a vulcanised rubber cover was placed on to keep in the steam. At the end of an hour the temperature read as follows:—



Tube with atmospheric insulator.....	167°	loss	45°
Naked tube.....	151°	,,	61°
Tube covered with composition	125°	,,	87°

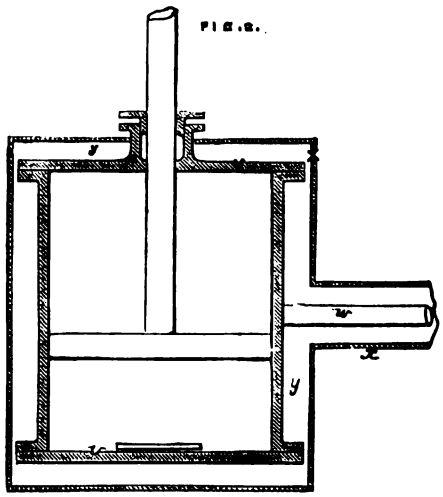
showing a gain in favour of the atmospheric insulator of 43° over the composition, and of 16° over the naked tube." So for the patentees. Our readers can judge for themselves now. In the illustrations, *a*, *a*, *a*, Fig. 1, is a section of a

FIG. 1.



boiler "insulated," *b*, *b*, setting, *c*, *c*, *c*, covering of wood or other material, *d*, *d*, *d*, air space, *e*, *e*, supports for covering; *u*, *u*, *u*, Fig. 2, show

FIG. 2.



transverse and vertical section of cylinder, *w*, steam supply pipe, *x*, *x*, *x*, covering, *y*, *y*, *y*, air space; in Fig. 3, *r*, *r*, *r*, is a transverse section of

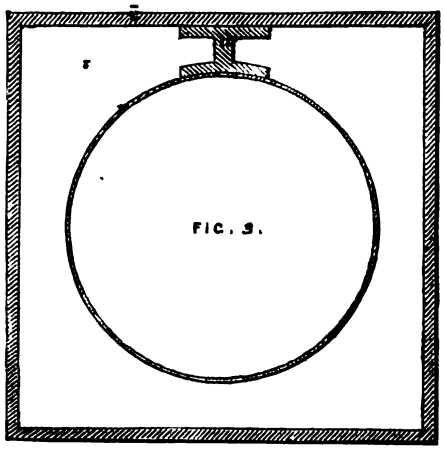


FIG. 3.

steam pipe, *s*, *s*, *s*, covering, *t*, *t*, *t*, air space, *u*, support.

It may be added that the principle is applied to workmen's breakfast and dinner cans, with, it is stated, excellent results.

GLEANINGS FROM SCIENTIFIC WORKS.

DR. T. THOMSON has shown that the size of an atom of lead cannot amount to so much as the 1—888,490,000,000,000th of a cubic inch.

THE decomposition of carbonic acid by plants is proportionate to the intensity and duration of the light to which they are exposed. The quantity absorbed is directly as the force of vegetation.

SOME meteorites which were found at Montauban, in the south of France, in 1864, and which were quite hot when picked up, consist of minute crystals of a rare kind of iron, and of sulphur, mingled with a peaty substance, which is held together by sulphate of ammonia. The sulphate dissolves when a portion of the meteorite is put into water, and the whole mass falls to pieces.

THE total area of the United States and its territories is 3,230,572 square miles.

THERE are 4,155 (German) miles of telegraphic wires spread over Austria, with 350 offices.

CRUDE saltpetre cannot be used in the manufacture of gunpowder. The crystalline flour, quite free from chloride, is the best material for the purpose. In France, the amount of chloride is not allowed to exceed $\frac{1}{3000}$. At the Waltham Abbey mills the washing process is carried so far that nitrate of silver produces no precipitate in a solution of the purified saltpetre.

IF the last week in February and the first fortnight of March be rainy, and attended with frequent appearances of the rainbow, a wet spring and summer may be expected.

THE velocity of the current through 3,000 miles of Atlantic cable, in 1858, as tested by the mirror galvanometer and Daniell's battery, was only 3,000 miles per second.

IN the manufacture of needles small fragments of metal are broken off, and are apt to be inhaled by the operatives. By placing magnets at the mouth and nose the inconvenience may be remedied.

THE following interesting results were obtained from the experiments of Dr. Edward Smith on the quantity of air inspired throughout the day and night under various influences. The total quantity of air inspired in twenty-four hours, allowance being made for intervals amounting altogether to 40 minutes, during which records were not taken, was 711,060 cubic inches; or an average of 29,627 cubic inches per hour, and 493·6 per minute. The quantity was much less during the night than during the day. There was an increase as the morning advanced, and a decrease at about 8h. 30m. p.m., but most suddenly at about 11 p.m. The average depth of respiration was 26·5 cubic inches, with a minimum of 18·1 cubic inches in the night, and a maximum of 32·2 cubic inches at 1h. 30m. p.m. The mean rate of the pulse was 76 per minute. The amount of breathing was greater in the standing than in the sitting posture. It was increased by riding on horseback, according to the pace, also by riding in or on an omnibus. In railway travelling the increase was greater in a second than in a first-class carriage, and greatest in the third-class and on the engine. Bending forward whilst sitting lessened it. The quantity of inspired air was increased by exposure to the heat and light of the sun, and lessened in darkness. When tea was taken an increase was the result; coffee caused a decrease. Supper of bread and milk also caused a decrease, but milk by itself or with suet caused an increase. An increase was obtained with the following articles of diet, viz., eggs, beef steak, jelly, white bread, oatmeal, potatoes, sugar, tea, rum. The following caused a decrease, viz., butter, fat of beef, olive oil, cod-liver oil, arrow-root, brandy, and kirchenwasser.

CAVENDISH showed, in 1784, that when electric sparks are passed for a long time through air in contact with water or an alkaline fluid, nitric acid is produced

A CORRESPONDENT of *Herapath's Journal* recommends Lydney, at the mouth of the Severn, as a site for building iron vessels of war and making guns, where every stage of the process might be economically carried out under one establishment on crown property.

COMMON lucifer matches are tipped with a composition of chlorate of potash and phosphorus, mixed with ground glass, colouring matters, and a little gum. The so-called noiseless matches consist of phosphorus, 4 parts; nitre, 16 parts; red lead, 3 parts; and strong glue, 6 parts.

ONE pound of the best sperm oil contains 0·12 lb. of hydrogen, 0·78 of carbon, and 0·10 of oxygen, and when burned in an Argand lamp robs the atmosphere of the oxygen contained in 13·27 cubic feet, or 2·93 cubic feet, and produces 2·86 lb. of carbonic acid gas, and 1·06 lb. of water

REVIEW.

Modern Marine Engineering. Illustrated with plates and woodcuts. By N. P. BURGH, Engineer. London: E. and F. N. Spon, Bucklersbury. Parts I and II.

A MOST unenviable task is that "set" to a reviewer when the first parts of any work are placed before him on which to exercise his judgment dispassionately. In the present instance we feel this acutely—having before us some of the most splendid specimens of the draughtsman's art we have ever seen in any work appealing to the engineer, with of course a batch of necessarily incomplete letterpress, which latter, by the way, we cannot help wishing had been as well done as the plates, when there would have been little fault to find. Mr. Burgh does not set up this or that theory and argue and illustrate therefrom; rather, he takes up the forms that have been found to answer best in practice, illustrates them with types, coloured lithographs, and wood engravings; and as the large plates are drawn to scale, the young engineer can take out his proportions easily. Part I is entirely prefatory, and we suppose, as such matter is generally looked for, it is properly so placed. Much is said in very little space. Thus, speaking of the screw, in which so many of our readers have shown so great an interest, he says:—"The modes for regulating the angle of the blades to the required pitch are now condensed into two kinds generally. The makers of the Mangin propeller, as a rule, regulate the pitch by slotted holes in the flange of the blade. The securing bolts or studs cause a fixed connection, and the diversity of the latter results from the loosening of the former. The Griffith's screw, alike with the 'Mangin production,' relies on the alteration of the angle, or rather the pitch of the blade. Rigidity being imperative, much depends on the means adopted to attain the same, studs and nuts and wedges seem to be the best, while in some instances the latter are dispensed with. When the wedges are not adopted, the locking of the stud heads is imperative; this preventitude of looseness is attained by separate plates being secured by studs between the head of each bolt or stud."

One of the plates in this part represents a three-cylinder expansive engine (in plain and sectional

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elevation) of 300 horse power nominal, fitted in the Russian iron-clad "Pervenelz" by the makers, Messrs. Maudslay. This engine was constructed under the patent of Mr. C. Sells. The second plate is a longitudinal elevation, half complete, half in section, of a supplementary inverted engine and surface condenser, constructed for the steamer "Frankfort" under the patent of J. F. Spencer. If we might suggest—though probably in parts to come the suggestion will be facted—it would be as well to give the proportion of parts in letterpress, with the "reason why." It is this will make the work really valuable to the young engineer as a text book, and as a work of reference to the senior.

In part II the prefatorial remarks are finished, and chapter 2 begins the work in earnest with the general arrangements of engines, profusely illustrated as remarked. Of the two large plates one is a longitudinal sectional elevation of the aforesaid three-cylinder expansive engines, and the other a side elevation (showing section of condenser) of Mr. Spencer's supplementary inverted engine and surface condenser, both plates quite equal in execution to those in the first part. To those who have not any high-class work on the subject, and of modern date, in their possession, we cordially recommend the work now issuing from the press. It will be completed in fifteen monthly parts, and will form one of the handsomest contributions to class literature of the day.

While on the subject we may express our hope that Mr. Burgh may find room in his work for some of the experiences of Mr. Murray, engineer, surveyor, of the Board of Trade; author of an excellent treatise on the marine engine, who, last session, read one of the most practical papers ever brought before the Institution of Naval Architects. His observations on combined cylinder engines are unique; and his conclusion respecting such, after a four year's observation, is that they do not give an economy of fuel and are apt to break down.

We may be pardoned for introducing here—it only shows how we live and learn—Mr. Murray's observations on some of the Peninsular and Oriental Company's ships which had fitted in them these combined cylinder engines:—"These vessels ('Poonah,' 'Delhi,' &c.) use steam of 25lb. initial pressure, expanded about six times in the two cylinders, the consumption of coal being about 3lb. per indicated horse power per hour. Now, there are several steamers belonging to the Cape Mail Company which consume only from 2¼ to 3lb. per indicated horse power per hour, and they use steam at 20lb. pressure, expand 5 times in a single cylinder, and, I may add, never break down! Like the P and O vessels, they are propelled by screws, with surface condensers, and superheat the steam. I have examined carefully the indicator diagrams of these simply-designed engines in the 'Saxon' and 'Roman,' and can affirm positively that the 'Saxon's' consumption is not more than 2¾ lb. per indicated horse-power, the 'Roman's' being nearly 3lb. Each of these vessels has made five double voyages to the Cape and back, a distance of 12,500 miles, without accident of any kind, the 'Saxon' burning 11¼ tons of coal per day, and the 'Roman' 12¾ tons, with an average speed of eight knots. The 'Saxon' is a ship of 1,200 tons and 220 horse-power; and the 'Roman,' 1,300 tons and 220 horse-power. When, therefore, we find such economical results following a high rate of expansion in single-cylinder engines, it surely seems inexpedient to complicate our machinery by expanding in two cylinders, more especially when steam of only 25lb. pressure is used. On one occasion, when the piston of one of the small cylinders in the 'Mooltan' gave way on the voyage, the engine was worked by passing the steam at once into the large cylinder, where it was expanded in the usual way, as in a single cylinder engine. When the consumption of fuel came to be reckoned, this proved to be the most economical voyage that the vessel had made, her speed being also undiminished! This untoward result was looked upon at the time as rather a good joke against one of our most talented marine engineers. Although probably accidental in a great measure, it still showed very plainly that there could be no great saving in the double cylinder engine." There was also in Mr. Murray's paper some excellent matter respecting superheating, and on boilers; and this admittedly excellent paper we trust will soon be in the hands of all marine engineers, including Mr. Burgh's—that is, if he has not already got it.

Here for the present we must leave the subject. We understand the last work of Mr. Burgh has met with much success; we predict for this the same reception, and shall look forward with pleasure to the issuing of each part, confident that the author will do his best on his favourite field of exercise.

THE STEAM FIRE-ENGINE.

THE days of the "manual" engine are numbered, and in a few years they will be as things of the past, excepting perhaps, as regards those supplementary "squirters," as they are irreverently termed by our *gamins*, perpetually on hand for the especial behoof of chimneys. They have done their work, and so—*sic transit gloria!*

Many a letter have we received from our provincial subscribers, almost beseeching in their tone, respecting the now world-known engines of Messrs. Shand and Mason, of Upper Ground-street, Blackfriars-road; and the illustrations and descriptive matter thereto appended is our answer to our correspondents. To begin at the beginning:—

In a French work, published exactly a hundred years ago, descriptive of our manners and customs at that time—written by an eccentric but observant French traveller, rejoicing in the eccentric cognomen of "Extreme Unction"—mention is made of a pump at London-bridge worked by "the vapour from boiling water;" but we fancy this must be but a traveller's tale, for we find no record of anything of the sort then existing at the spot. The first introduction, then, of steam fire-engines to the notice of the public was by Braithwaite, in 1830—he having constructed one which was noticed and described in the Scientific Press of the time; and two years later we find figured and described one made by him for the Prussian Government. From some cause they were not adopted, and little more was heard of the steam fire-engine for twenty years, when, in 1852, the London Fire Engine Establishment had steam power put to their floating engine, then stationed at Southwark-bridge. This engine had been formerly worked by 120 men; and so advantageous was the alteration that in three years thereafter Messrs. Shand and Mason were induced to design and construct an entirely new floating steam fire-engine, in which the steam engine propels the boat to the scene of conflagration, and there works the fire-engine. The engines are nominally of 80-horses' power, but are frequently worked up to double that amount. When worked at 100 revolutions this engine delivers 2,000 gallons of water per minute through four 1½-inch jet pipes, or through twelve jet pipes of the size used with the "manual" engine.

It was not till 1858 that steam fire-engines for land service were again brought forward, when this most enterprising firm made their first land engine, tried first at the Grand Surrey Canal, as many will remember, and then sent to St. Petersburg, where, we believe, it is still in use. In April, 1860, Messrs. S. and M. supplied the London Establishment with one of the same description, on approval for 12 months, which was found so satisfactory—as everybody knows—that at the end of the year one of an improved construction was purchased; and this, with another of the same description as that which they had on hire, and which Messrs. S. and M. had then in their shop, worked with eminent success at the great fire in Tooley-street—and, combined with the immense advantage gained by working the floating engines by steam, established indisputably the superiority of steam over hand work for the purpose. We will now proceed to describe the various illustrations, as noted in the specification. A is a view of the horizontal, and B of the vertical fire engine, ready for starting to the scene of conflagration. The invention, the subject of the specification referred to, relates to various improvements, which consist in employing a vertical double acting steam cylinder placed in an inverted position directly over and concentric with a water cylinder fitted with bucket and plunger. The plunger is connected direct to the steam piston by two rods, and to a crank (working between the steam and water cylinders, and also between the said rods) by a connecting rod jointed to the bottom of the plunger. The water cylinder has a vertical frame cast on the top, the upper end of which forms a cylinder bottom, to which the steam cylinder is bolted; this vertical frame also carries the bearings of the crank shaft, and on this shaft a fly-wheel and eccentric for working the slide valve and feed pump are fixed. The water cylinder, or fire-engine apparatus, is constructed with valves and air vessels, and the delivery has two outlets for attaching hose, and is fitted with a stop valve, which can shut off either of the two outlets, but only one at a time. This engine is fitted with a self-acting governor; the framing is formed of two metal tubes placed longitudinally, and forming receptacles for branch pipes, stoking irons, or other articles; to these tubes the boilers and hind springs are fixed. There is also a sheet metal trough in front on the under side, to which the plate of the locking carriage is fixed; and on the upper side a tool box, with driving seat and footboard and seats for firemen; under this box is a receptacle for hose, which can be placed in coils or wound on a reel. The boiler is in front of the hind axle, and the steam and fire-engine apparatus at the back, but fixed to the boiler. The hind springs are made of steel plates in the usual manner, but combined with spiral springs and india-rubber stops to provide a better action and to reduce weight. There is a furnace door in front and a coal bunker fixed to the fore locking carriage.

The invention relates also to improvements in the construction of the boilers. The boiler is a vertical tubular and the outer shell surrounding the tubes is cylindrical. Two detached semi-circular chambers, of thin sheet metal, fill up the space between the tubes and outer shell; these chambers communicate with the steam space by means of tubes, and to the external atmosphere by cocks fixing the chambers to the shell of the boiler; these cocks are used to empty any condensed steam that may accumulate in the chambers; the use of the chambers is to reduce the quantity of water in the boiler, causing steam to be raised more rapidly, and to increase the steam space. The boiler is so constructed that the upper part of the shell may be readily detached by means of the bolted joints F and G in Fig. 1, thus allowing complete access to the tubes and internal part of the boiler.

Fig. 1 is a longitudinal section, showing the construction of the boiler, steam-engine, and pump. The fire-box A is of conical form, so as to give space for a large fire-grate or furnace. The fire-box communicates with the smoke-box B, and the chimney by the vertical tubes C. To diminish the water space and increase the steam space two semi-circular metal cases or pockets D are fitted into the boiler round the space occupied by the tubes C. The casing D communicates with the steam space by two or more open pipes E, which ascend above the water level, and small cocks are fitted in the bottoms of the cases D through the sides of the boiler to draw off condensation water. The top of the smoke-box can be taken off to repair the tubes, &c., by unscrewing the joint at H. The engine is composed of an inverted steam cylinder I, placed above and concentric with the pump K, which parts are framed together with the four bars L, which connect the enlarged head of the pump with the cylinder bottom, and which frame L also carries the bearings for the crank shaft M. The pump is fitted with india-rubber discs, which form the foot valve. In action, the suction is drawn in the up-stroke by the bucket O, and in the down-stroke about half the water is discharged by the displacement of the plunger N, and at the next upstroke the remainder of the water is discharged by the ascent of the bucket. The enlarged head of the pump K is fitted with a large air vessel Q, and nozzles to take the hose at R. Over the openings to these nozzles at S is fitted a valve, shown in plan at fig. 3, which is so constructed as to admit of both outlet passages being open or to close either at pleasure, but not to close both outlet passages at the same time.

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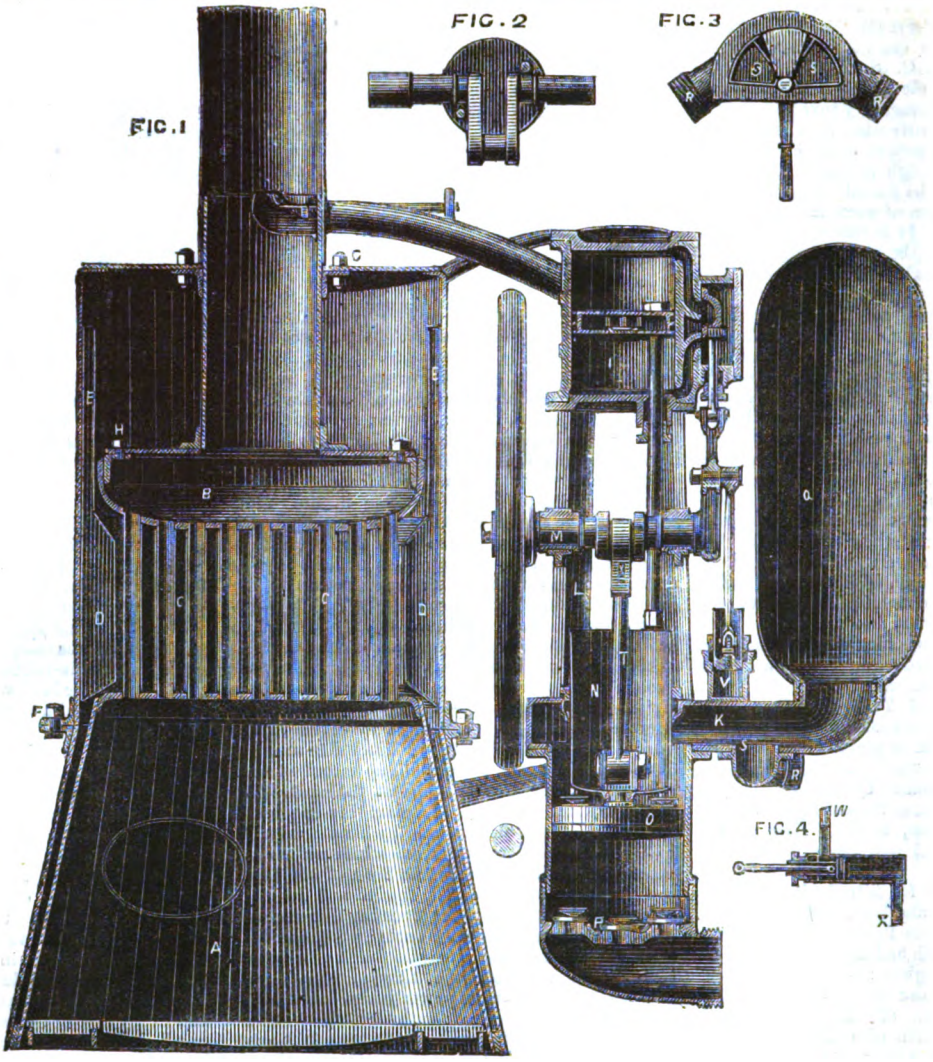
The connecting rod T is jointed to the bottom of the pump plunger N, which is itself attached to the steam piston by two piston rods, between which the crank works, as shown in plan in fig. 2. Upon one end of the crank shaft M is keyed a fly-wheel, and upon the other end an eccentric, which works the slide valve and the feed pump V. Fig. 4 is a section of the governor, which is constructed with a piston fitted into a cylinder, with a trunk and stuffing box; the connecting link from the piston is attached to the lever of the regulator, the pipe W is connected with the steam jacket of the cylinder, and the pipe X with the enlarged head of the main pump, so that any change in the pressure of the water in the pump will cause the piston of the governor to be moved by the pressure of the steam, and thus regulate the admission of steam to the steam cylinder of the engine.

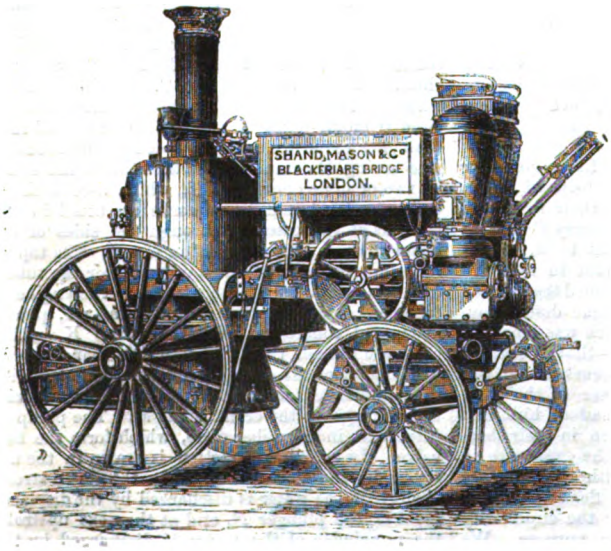
Did space permit we could fill column after column with descriptions of the immense success which has attended the engines of Messrs. Shand and Mason. One slight fact will testify to their



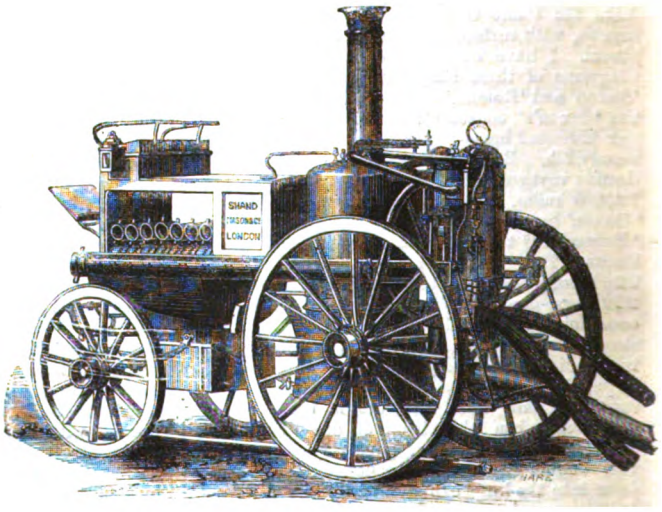
tried at the Deptford dockyard. The fire was laid with wood and shavings, and steam was raised to a pressure of 60lb. per square inch in 11 min., 10 sec. The water was drawn from a depth of 12 feet, and a jet from a nozzle 15-16ths of an inch in diameter was thrown 218 feet horizontally, the steam pressure being 125lb. and the water pressure 103lb. per square inch. Previous to the trial, at the same pressure, a jet was thrown 40ft. above a chimney shaft 120ft. high, or a total height of 160ft. This little engine ($1\frac{1}{2}$ tons) is to be sent to Bermuda. It may be mentioned that indicator diagrams taken from the engines of this firm show that one horse-power is exerted for each hundredweight of the weight of the engine—which is an excellent result.

There remains but to add that Shand and Mason are finding a rapid market not only at home but far away, on the continent of Europe, &c. Though lacking space we do not lack matter, in connection with these engines; and at any time we shall be happy to supply inquiring readers with

A



B



value. When, following the terrifying cry of "Fire! Fire!" the steam fire-engine is seen tearing along at the full speed of two or three horses—sparks flying "far abaft," as the steam is got up *en route*—the excited populace rushing to the scene of conflagration, halt in their career, and exclaim to each other, "There's Shand and Mason—the fire's as good as out." Truly its work is wonderful, and the patentees and manufacturers are deserving of every success which can possibly follow spirit and perseverance.

A few days since one of the engines was such short details as they may require. What we have above given exactly covers the ground taken by subscribers, and we cannot help expressing the hope that soon, in their respective localities, they will be able to examine a "real engine" for themselves.

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THE LATHE AND ITS USES.*

V.

It is not always an easy task to chase a true thread on a piece of work, and even "the boldest holds his breath for a time," if he has a nice piece of work all done but the thread, and that in a critical part. It is so easy to make a drunken thread, or one in which the spirals are not true, but diverge or waver in their path around the shaft, that many are made. That they are more common than true threads, is well known to mechanics. To start a thread true is quite easy with an inside chaser; for, strange as it may seem, it is seldom that drunken thread is made on inside work; only have the bore itself true and the chaser will run in properly. The case is different when a bolt or shaft is be cut. With fine threads, the slightest obstruction on the rest will cause the chaser to catch and stop slightly. No matter how slight the stoppage, it is certain to damage the thread. The injury is more perceptible on fine threads than on coarse, for in the former, if the threads do not fit (as they will not if they are drunken, one crossing the other, when both parts are put together), the drunken thread will not come fair with the other. In coarse threads, however, it will not be so apparent, for, by making the drunken thread smaller, it will have play and accommodate itself to its place. This is not workmanship, it is "make-shift."

To chase a true thread the rest must be smooth and free from burrs or depressions. Nice workmen keep a special rest with a hard, polished steel edge expressly for this purpose.

If the chasers themselves are smoothly finished at the bottom, on an emery wheel, they are all the better. With these precautions, and others noted below, success is certain. When a thread is to be started, take a fine diamond-pointed tool and hold it on the end of the shaft to be chased. Set the lathe going, and give the tool a quick twist with the wrist, so that a spiral will be traced on the work, like this figure.

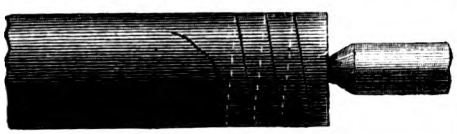

FIG. 16.

Some part of this will correspond with the pitch of the thread to be cut, and there is less liability of making it drunken. By a little practice one is able to hit the pitch of the chaser exactly in making a start.

"There is no trouble, after you once know how." We have chased quantities of small screws with 48 threads to the inch, and not a sixteenth of one inch in diameter. If the chaser once hesitates on such screws, they are spoiled. For heavy threads —seven and eight to the inch, which is about as hard work as any man wants to do, it is the custom of some turners to use a tool with only two teeth, and some use only a sharp-edged cutter, like this—

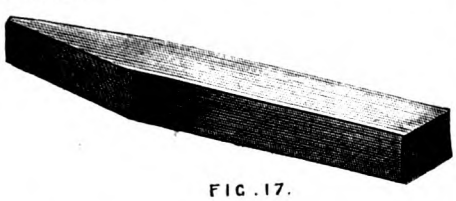

FIG. 17.

to deepen the thread, the chaser being used afterward to rectify the job. There is danger with this tool, unless it is used by an expert, of digging out the thread, so that the last end of it will be worse than the first.

Another tool used in chasing heavy threads is a doctor. This consists in having a fac-simile of the thread to be cut on the back of the chaser and in applying a short set screw behind, so that as the iron is cut away the chaser may be followed up behind. This is the doctor, but the follower opposite the chaser is too narrow, and should be made nearly half a circle to avoid slipping; with this exception it is all right.

These tools, and the screws made by them, are all inferior to those made by lathes with traversing mandrels; that is, a mandrel which slides in and out of the head rest, as in a Holtzapfel lathe.

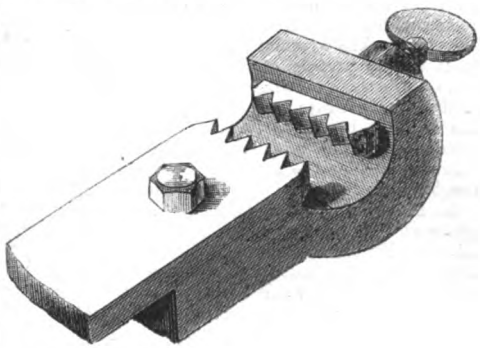

FIG. 18

This lathe has a series of hubs, unlike the one shown previously, slipped over the back end of the lathe spindle (furthest from the workman) and a fixed nut on the head-stock, which being put in communication with the hub on the mandrel, drives the same in and out according to the direction the cone pulleys are turned. Of course, with such an attachment as this, there is no danger of making drunken threads, for the hubs which start the threads are cut with a train of gears in an engine lathe, so that it is impossible for them to be incorrect. Moreover, a square thread, or a V-shaped thread can be made with them, which is not the case with common chasers.

In lathes that have traversing mandrels to cut screws, the tool itself remains stationary, but as this is obviously a disadvantage in many kinds of work, it is far better to have the tool advance and the mandrel revolve as usual. By this plan much time is saved, a greater range of work is possible with the same gear, and a piece that is chucked, or one that is between the centres can be cut with equal facility.

Any common lathe can be rigged to do this by putting a shell on the back end of the mandrel between the pulley and the set-screw, and slipping the hub over the shell, with a feather, to keep it from turning. To take a thread from this hub, a round bar must be set parallel with the shears in easy working guides. The bar must have an arm at one end to reach over to the hub, said arm to be fitted with a piece of hard wood to match the thread on the hub. The other end of the bar has the cutting tool in it; of course at right angles, so as to run in to the work and bear on the tool rest. The tool is held in the bar by a set screw, so that it can be lengthened or shortened.

By this arrangement a true thread can be rapidly generated on any rod, hollow cylinder, or other kind of work—the pitch depending on the pitch of the hub.

It is necessary to have as many different hubs, varying in pitch as there are different kinds of work to be done, and although the thread on the hub is only an inch or half an inch long, perhaps, a screw of any length may be cut on a rod by simply shifting the cutter on the rest. This same bar is also useful for turning, as with a slide rest, for, by sliding it along gradually, it acts in a measure like a fixed tool in a slide rest.

From these hints the amateur who takes a lathe in hand for the first time, or is at best a neophyte, may learn much to his advantage. Persons of a mechanical turn only need a hint, when the mind springs to the conclusion with surprising rapidity.

FIG. 19

This little tool is very handy in many instances, particularly for running under the necks of screws when the thread is cut up to the head. By so making them the head comes fair down upon its bed and holds much better.

* Mostly compiled from *American Journals*

FREEZING AND COOLING LIQUIDS.

This invention has reference to a simple and economical apparatus, which may be constructed in the form of a decant a rorr,c afe, for the purpose of obtaining ice, or for simply iceing or cooling liquids, and consists in the employment, for such purpose, of an outer and an inner vessel of glass, or other suitable material, each of which is provided with a separate mouth, or orifice, of its own — the two vessels being so disposed that there shall be no communication between their interiors. For this purpose, the neck of the inner vessel is brought through the side, or other convenient part of the outer vessel, and is provided with a stopper of its own, whilst the outer vessel is provided with the usual or other neck, suitable for decanters or water bottles, if the apparatus is required for use on the table; any shape or configuration may, however, be given to the two vessels. The relative capacities of the liquid spaces of the two vessels should be in the following proportions—namely, if the capacity of the inner vessel be 1 quart, that of the surrounding space inside the outer vessel should be about 0·750 of a quart. The inner vessel contains the freezing or cooling mixture, and the outer one the liquid to be frozen, iced, or cooled. Any well-known freezing mixture may be used, but it is preferred to employ the following, viz.:—

Sal ammoniac	5 parts.
Nitrate of potash	5 ,,
Water	16 ,,

OR,

Nitrate of ammonia	1 part.
Hydrated carbonate of soda	1 ,,
Water	1 ,,

The annexed engraving represents an elevation of a carafe constructed according to this invention. A is the external vessel, and B the internal one, which is blown inside the first. The liquid to be iced is introduced through the neck, *a*, which is closed by an ordinary stopper, C, whilst the freezing ingredients are introduced into the vessel, B, through the mouth thereof, which passes through the side, or other convenient part, of the outer vessel, A, and is closed by a ground stopper, D. E is the handle of the complete apparatus. In some cases the inner vessel may be connected to the outer one by screwing, so that when used for iceing the two may be combined, but when no longer required for that purpose they may be disconnected from each other.—Extracted from the *Practical Mechanic's Journal.*

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BALLOON ASCENTS.—III.*

(Illustrated on Page 254 ante.)

Thus treated, when the sky was cloudy, it was found that on the ground the degree of humidity was 74; increased to 78 at 3,000 feet; decreased to 73 at 6,000 feet, and then gradually to 22 at 21,000 feet. The law of moisture shown in cloudy states of the sky, was therefore a slight increase from the earth, to 3,000 feet high; then a slight decrease to 6,000 feet, the degree of humidity at this elevation being nearly of the same value as on the ground—from 6,000 to 7,000 feet there was a large decrease, and then an almost uniform decrease to 11,000 feet.

On the contrary, with a clear sky, on the ground the number found was 59, increasing to 71 at 3,000 and 4,000ft.; then decreased to 50 at 9,000 feet high; and much smaller on ascending higher, to 16 only at 23,000 feet.

The law of moisture here shown, is a slight increase from the ground to 1,000 feet high, a considerable increase between 1,000 and 2,000 feet; a nearly constant degree of humidity from 2,000 to 5,000 feet, and then a gradual decrease to 12,000 feet. At greater heights the air is very dry.

By comparing the results as found from the two states of the sky together, the degree of humidity of the air, up to 1,000 feet, was 15 less with a clear sky than with one covered by clouds; from 2,000 to 5,000 feet it is from four to six less; at 6,000 feet the air with a clear sky is much dryer than at 5,000 feet, but with a cloudy sky it is nearly of the same degree of humidity, so that the difference between the two states is large, amounting to no less than 11. Above 12,000 feet the air, with clear skies, generally becomes very dry, but with cloudy skies frequently becomes more humid, as was to be expected from the presence of clouds at the height of three and four miles.

In both states of the sky at heights exceeding four and five miles the air becomes very dry—the amount of water present being very small indeed; but at the highest elevations I have been, there has always been some water present—I never found the air free from water. At the same elevations the results of experiments on different days were found to be very different; and on the same day water was found to be very differently distributed, there having been met with several successive layers of dry and wet air placed one above the other. . .

In the observations made on solar radiation, the sun is the great source of light and heat, and no observations ever had been made on the effects which the sun produces on blackened-bulb thermometers, freely exposed to his influence when beyond the influence of the earth.

The first instruments used for this investigation were thermometers as delicate as those screened from the sun, usually located near to the dry-bulb thermometer, but readily removed to any other position within the sun's influence. It was soon found that the excess of readings was very small; and at the height of five miles high, with a brighter sun than on the earth, the difference, if any, was very small indeed; at the heights of 4 miles, 3 miles, 2 miles, the difference became larger, and increased on approaching the earth.

Having advanced thus far in the inquiry, with results differing a good deal from those expected, it became a matter of considerable importance in reference to our knowledge in this respect, and as possibly leading to some information which might tend to some quality in the heat-rays, to confirm these results by the use of other instruments; for it was just possible that the small projecting bulb of a thermometer, kept free from all objects to reflect or conduct heat to it, might receive them from the sun, and by the quick and constant motion of the balloon, might at once part with them again to the cold air in immediate contact with the bulb. Another and similar thermometer, enclosed in a vacuum tube, was used, the bulb being surrounded by a large glass globe, admitting the heat to pass directly to the bulb, but parting with none to the surrounding air; the results by the use of this instrument seemed to confirm those previously found.

These researches led to the use of Herschel's actinometer, shown at the extreme right hand in the plate. . . .

The general results from its use are as follows:—That, when on the ground, the number of scale divisions increasing in a minute were between 40 and 50; at the height of three miles, with a deeper blue sky, and a brighter sun, the increase in the same time will be but seven or eight divisions, agreeing with the previous series of experiments.

These remarkable results lead us to new ideas respecting the passage of the heat-rays through space. From them, it would seem as highly probable that the heat-rays from the sun pass through space without loss, and become effective where wanted only, and in proportion to the density of the atmosphere, or the amount of water present, through which they pass; and if so, the proportion of the heat received at Mercury and Venus, Jupiter and Saturn, may be the same as that received at the earth, if the constituents of their atmospheres be the same as that of the earth, and greater if the density be greater; so that the effective solar heat at the superior planets, Jupiter and Saturn, may be greater than at the inferior planets, Venus and Mercury, notwithstanding their far greater distances from the sun.

If this be true, then there will be no need to refer to the law of the decrease of radiant heat, viz., that of the inverse square of the distance, as applying to the temperatures at the different planets, a law which gives to the surface of the sun such an intense heat, far beyond any we have the power of producing, and in such amount, that no theory that I have seen advanced would seem capable to supply the continual demand. . .

Let us now turn to another investigation still connected with the sun—one of absorbing interest, one promising to tell us something about the constituents of the sun itself. The spectroscope directed to the sun, as is now well known, shows the solar spectrum crossed by dark lines. Some observers attribute some of these lines to our atmosphere; and it became a subject of inquiry of deep interest, to ascend above the lower portion of the atmosphere, and examine the solar spectrum there. . . .

The spectrum at all times was found to be brighter and the colours purer than when viewed from the earth; also every line seen from the earth was seen from the balloon, but all better defined and more distinct. The line H, as seen from the earth as nebulous, was seen as made up of fine parallel lines; and generally the spectrum was longer, the lines more numerous, the colours brighter, as seen at a high elevation, than when viewed from the earth.

Let me now briefly refer to a few facts connected with the wind. Firstly, to the currents in the atmosphere. These were found to be very different, and a good deal of information was collected in relation to them, in the twenty-five different ascents: in all it was found that the velocity at the earth's surface was very much less than at high elevations.

The aneroid barometers at first failed, an inch graduated on the dial plate was not an inch, but ultimately the results were as good as those by the mercurial barometers. Of the several hygrometrical instruments, there was very little difference in the results, as found by different instruments, and then the dry and wet-bulb thermometer is found to be a perfectly trustworthy instrument up to considerable heights. A magnet was found to occupy a little longer time in vibration when high up than on the earth, and therefore magnetism was slightly less in intensity.

The results which have been obtained by the balloon ascents already made, give us a good deal of information upon points in which we could gain none by any other means. Those made upon the decline of temperatures instruct us that we must again investigate the laws of refraction, and they indicate that the laws of refraction good at one place may not be good at another; for we may infer that the state of things existing at different observatories, differing the one from the other so greatly, may require a special determination of the laws of refraction, as applicable to those different states.

* The major part of the matter of this article is extracted from a paper in the *Popular Science Review* by James Glaisher, F.R.S.; the illustration is also from the same source.

THE ORIGINAL SCREW PROPELLER.

Three years ago a statue of Josef Ressel was erected in the square opposite the Polytechnic Institute of Vienna, commemorating him as the original inventor of the screw propeller. Ressel was born in Bohemia, and, at the time of his engineering labours held an appointment in one of the departments of the Austrian Government, we believe it was that of Woods and Forests. In 1826 he worked a small screw propeller by means of the strength of two men, in a boat upon the Danube. In 1829 he fitted a screw, of 5 feet diameter, to a boat then at Trieste, and with a six-horse engine he steamed out to sea, and attained a speed of six miles an hour. This screw, of which Mr. Bennet Woodcroft has a sketch, had one half of a convolution, being shaped like a portion of the blade of an auger. On returning from sea, some trouble was experienced with a leaky steam joint in the engine, and the police, acting under the authority of a paternal government, forbade all further trials of the apparatus. Ressel died in 1857, and Herr Karmarsch gave a comparatively full account of his labours in *Unsere Zeit* for July, 1863. Mr. Woodcroft has, however, additional and exact information upon the matter. When the Americans take the trouble to place all their mechanical achievements on record, it will be found that John Cox Stevens was one of the first, if not the very first, to apply the screw propeller to a steamboat. This was in 1804. The propeller, we believe, is still in existence, and it has been seen by many gentlemen of our acquaintance. Mr. Stevens was a wealthy, and withal an ingenious merchant, living in New York. He patented one of the first tubular boilers in England in 1806, and was one of the most successful pioneers next to Fulton and Chancellor Livingston, in the introduction of steam navigation upon the River Hudson. His sons were for a long time leading engineers in the States, and were, at the same time, large capitalists. One of them was the designer and owner of the Stevens battery, of which a good deal was heard three or four years ago. It should not be forgotten that Watt, in a letter to a friend, in 1770, proposed and made a sketch of a "spiral oar," much like Ressel's, and besides other inventors who patented the screw in various forms, that remarkable locomotive engineer, Richard Trevithick, also described it in practical terms in the specifications of his patent of 1815. It may be truly said that the occasion suggests the invention, and the success of later inventors, say Ericsson, Woodcroft, and F. P. Smith, has been to a great extent the result of opportunity.—*Engineering.*

IRON-COATED SHIPS. — The director of naval architecture in France is of opinion that, unless some composition capable of preventing rust is discovered, an iron plated fleet must be renewed every five years: the *Provence*, which was fitted out for sea only fifteen months since, being found, while undergoing repairs at Toulon, to have a great number of her plates nearly consumed with rust.

HIGH PISTON SPEED.—One of the leading firms of marine engineers on the Thames, is about taking in hand a contract for large engines of 5 ft. stroke, which are to make 60 revolutions per minute, corresponding to a piston speed of 600 feet.

CUPOLA FURNACES.—Mr. Evan Leigh, of Manchester, has patented the substitution of a chimney for fans or other blowing apparatus for cupola furnaces. He says nothing, however, of the height of chimney he would require to get up a draught of even 4 or 5, not to say 16 to 20 inches of water, nor of the quantity of heat which the chimney would absorb before it began to draw properly. We know a chimney 140 ft. high, which draws eight-tenths of an inch of water, and the draught is considered very good.

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LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

PRACTICAL PHOTOGRAPHY.

Sir,—"Plodder" having now commenced his instructions on Photography I must point out to you *two* very great mistakes in the formulæ for *Bath*, page 228, col. 3, more especially as he states on page 248, col. 1, that he uses the same bath for both negatives and positives.

Formulæ given :—

Nit. Sil. 40 grs. to the ounce of water.
Io. Pot. 4 grs. } add 1 drm. of this solution to each
Water 1 oz. } ounce of the bath.
Neutralise—filter—4 or 5 drops Nit. Acid to 6 oz. of bath.

Now, Sir, as with Iod. Pot. 4 grs.
Water 1 oz.

every dram contains ½ a grain Iod. Potm., and which is by far too much to be put into 1 oz of a 40 gr. bath : but this is the old method of saturating a bath with Iod. Silver. I use a much more simple and preferable plan.

After the bath is neutralised with Carb. Soda, he filters, and adds 4 or 5 drops of Nit. Acid to 6 oz. bath.

This will be all very well for positives, but a ruination to the obtaining of brilliant negatives. If a bath is *just neutral*, 1 drop of Nit. Acid to 1 pint is ample.

On page 248, col. 2, I object to his recommending the amateur to practise with a bottle of water, instead of collodion, on a glass plate, as they are of different densities.

Water will not flow properly on a glass without being previously wetted, but any kind of oil will, and may with advantage be substituted for the collodion, for the practice of covering glass. Again, I object to fig. 2 method of holding glass, as the portion of glass where the tips of the fingers touch will necessarily be much warmer, consequently will be more sensitive than the other portion, resulting in patches by uneven development. On the 3rd col. he gives instructions for cleansing a bath, after some days' usage. This is very bad advice, for so long as a bath works free from streaks and fog, it ought never to be "doctored," and stains resulting from the accumulation of ether and alcohol in the bath, are easily remedied by the addition of a little alcohol to the developer. I object to pipe-clay, chalk, or whiting, being used to neutralise the bath, the proper ingredient being oxide of silver, or carbonate of silver.

On page 268, col. 2, he says, "A plain wet plate may be carried in the dark slide for about five minutes to take a distant object, provided the day be not very warm."

I suppose he means a wet sensitised collodion plate? Let me tell him that in the hottest July days last summer, I have taken a wet plate and run two miles to expose it, and by the time I have returned it has been out of the bath 35 minutes.

The instructions of "Plodder" for out-door portraiture, are very good.

In my answer to Stain and Polish, page 279, col. 3 you have put "take 1 oz. of nitrocis acid," it ought to be nitrous acid.

AN OLD HAND.

RIVETTING MACHINE.

Sir,—In the number of your paper dated Jan. 26th, you give a brief description of a new rivetting machine, in which you state that Mr. Kennard proceeded no farther in the matter than to receive provisional protection, and that therefore others may be able to couple parts of the improvements with their own, and proceed to a more successful issue than did Mr. Kennard. As such a statement is liable to mislead your readers, I will thank you to give the same publicity to this communication.

The patent of the duplex rivetting machine here in question was recommenced in June last with amendments, according to a practice now long established, and very extensively made use of in such cases, whereby the entire subject matter contained in the first provisional specification was protected, and that consequently any use of the invention there described, whether with or without the addition of improvements, would be an infringement of the patent rights.

This patent embraces the whole of the subject matter in your description, together with new arrangements for rivetting work that is not capable of being rivetted by ordinary rivetting machines. The latter is accomplished by having the two opposite slides in which the rivetting dies are fixed, made to project upwards so as to stand higher than the top of the machine, and are provided with one socket for the dies near the upper edge of such projecting part and another socket lower down. For rivetting ordinary work the dies are placed in the lower sockets, but for rivetting those parts of girders that have heretofore been inaccessible, such as the top and bottom flanges, the dies are placed in the upper sockets of the slides, and the girder is turned over on its edge in such a position that the flange to be rivetted is situated between the two dies, whilst the web and the other flange of the girder overhang one of the projecting slides.

Another improvement consists in using in conjunction with the machine a large pair of jaws or nippers projecting any required distance beyond the framing, and formed to suit any particular kind of work. The upper ends of these jaws are provided with sockets carrying the requisite rivetting dies, and they are actuated by means of the above mentioned slides or rams which carry the dies when the machine is used for ordinary work. These jaws or nippers are capable of being turned round to any angle, and so rendered suitable for rivetting at any angle from the vertical to the horizontal.—Yours faithfully,

KENNARD BROS.

Crumlin Viaduct Works, Jan. 31st, 1866.

HYDRAULIC PRESSURE.

Sir,—Archimedes enquires how a steam-engine is worked by hydraulic pressure instead of steam. Enclosed is a tracing of Joy's hydraulic engine, which I think is what your correspondent requires. Fig. 1 is a side elevation, A is the cylinder, O, attachment from piston rod, S, rod attached to lever, N, which is attached to stop-cock, M, I, four-way-cock for driving slide valve, J, lever, with rod, K, attached from arm, P, with tappet blocks, which move the four-way cock, I, for driving slide valve.

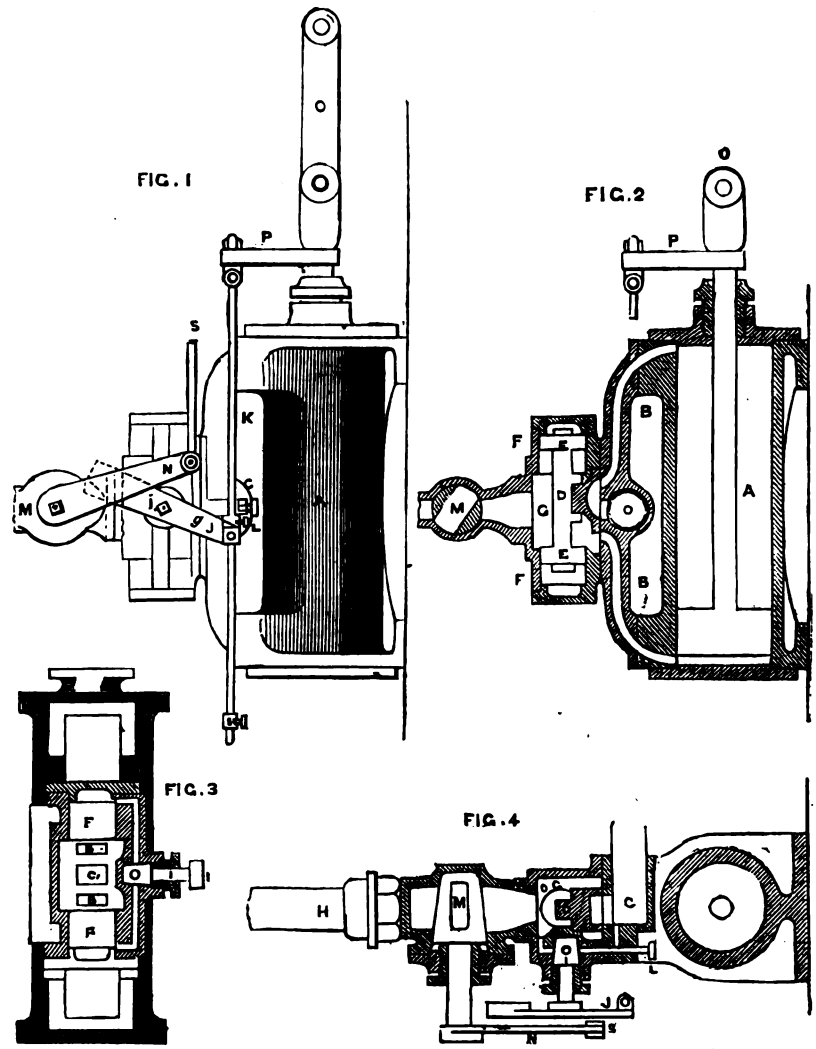


Fig. 2, vertical section. A, cylinder, B B, inlet ports, E E, double piston for driving slide valve, F F, cylinder for same, G, valve box, D, slide valve, C, exhaust, M, stop-cock in feed pipe, P, arm attached to piston rod for driving tappet motion connected to four-way-cock, I.

Fig. 3. F F, cylinder for double pistons to work in, B B, inlet ports, C, exhaust, I, four-way-cock.

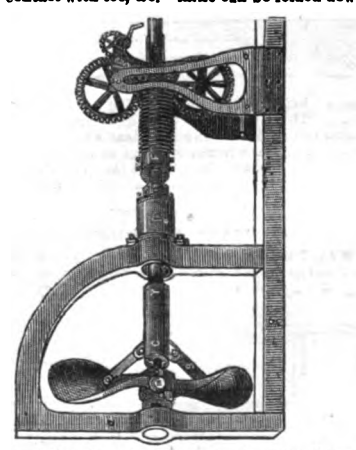
Fig. 4. H, water main, M, stop cock through the same, G, valve box, D, slide valve, C, exhaust, M, lever connected to stop cock, M, J, lever connected to four-way-cock, I, L, screw for regulating the escape from cylinders, F F, A, cylinder.

H. GRAY.

FOLDING SCREW PROPELLER.

Sir,—Months since, in answer to your invitation "to all and sundry," I set to work at a screw propeller, designed to "bite" well at any angle, which at the same time should possess rigidity, without which a screw propeller cannot be of much account. How far I have succeeded let the annexed sketch and explanation tell; that the idea may find favour with yourself and my brother mechanics I sincerely hope and trust that any imperfections may be noticed and the "subject" ventilated by those qualified to give an opinion. The frame constituting the rudder post and stern post is lettered *a, a, a, a ; g, g* is the keel seat. A, screw boss, keyed fast to propeller shaft—the screw blades are fitted with journals at their bases (*m*) to the boss A. C is a boss fixed to the shaft at *y*, and slides back and forward on the shaft at X : the boss is grooved and the shaft feathered so that both must go round together. D is a cylinder fitted to the stern post to admit the boss C; it is made wide enough to let the water escape ; it has a solid end at E, with hole, through which the shaft moves tightly. E is a stuffing box. F is a boss fixed to the shaft at F, and slides on the shaft at Z. This boss is fitted with teeth which go right round ; so that when the crane G is put in motion the teeth of the wheel corresponding with the teeth of the boss, the latter is propelled backward or forward as may be desired. B, B, are strong bars hinged to the screw blades, and the boss G, so that when the crane is put in motion the blades fold down towards the shaft, or *vice versa*.

I claim for my folding propeller an advantage over feathering propellers—viz, that while both will permit the vessel to be propelled at different speeds without altering the steam pressure, in the event of the propeller being an incumbrance—such as by a break down of the engine coming in contact with ice, &c.—mine can be folded down



on the shaft, and thus be out of the way. Any number of blades may be used. The blades are twisted to an angle of 45° immediately above their journals.

ALEX. F. THOMSON.

2, Russell Street, Grahamston, Falkirk, N.B., Jan., 1866.

[Our correspondent, who has occasionally favoured us with a sight of his plans as he progressed, deserves every praise for his perseverance, for we know he has worked hard. We anticipate some notice being taken of this by our readers, which we shall be happy to find room for—if brevity be consulted.—ED. E. M.]

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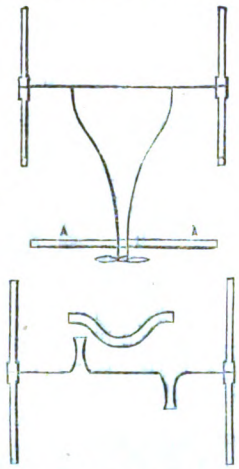
THE VELOCIPEDE QUESTION.

Sir,—The letter by "J. Robison," with diagrams upon the velocipede question, relates to my ideas very closely, for it is singular that some years since I hit upon the same method, throwing in and out of gear the driving wheels. Now, for the first time, I see that others have had the same notion, and I shall not consider the subject any farther in reference to a patent. I think if those who are constructing velocipedes were to have a rail fixed in front of the seat that the arms could be rested upon occasionally; and also

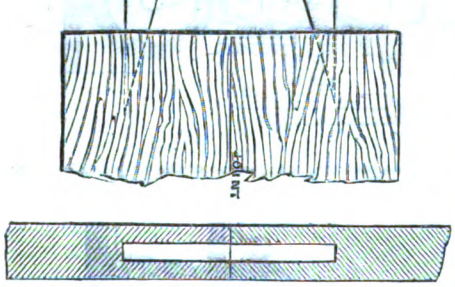


so arrange that upon this rail the guiding handle could be held steadily, it would be a great advantage, for unless the guiding can be managed firmly, it causes great exertion; at least I have found it so in many velocipedes I have tried. I enclose a sketch, which I think explains itself. I should like to see the velocipede brought to perfection.

The part marked A, A, is the rail I propose for a rest for the arms of the driver; and also to rest and hold fast the handle for guiding. N. N. N.

CRAMP FOR JOINTS.

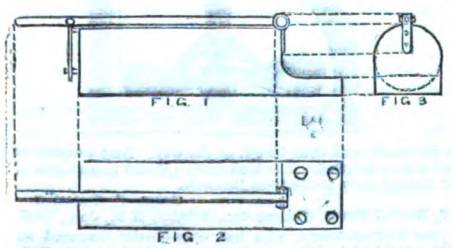
Sir,—As one of your regular readers, I here offer a little scrap to my fellow workmen in the wood line, in the shape of a small powerful cramp for joints, one that can be used at both ends of joints after a little experience. The cramps will be found useful in many ways. I have called them



dogs being something similar to the old sawyer's pit dogs. Their great strength and simplicity—for they are never out of order—saves a deal of time, and a workman can put as many joints together as he likes, and as he can also plane the work over while the joints are drying, they are really of great value in a shop. JOHN MARGETTS.

CRAMP FOR SOLDERING.

Sir,—I send a sketch of a cramp which is easily made and works well. Fig. 1 is an elevation, fig. 2 a plan, and fig. 3 an end view. It consists of a cylinder of wood



screwed down on to the bench with an iron lever, jointed at one end, and having a link hung free at the other as shown. The wood cylinder is made an easy fit for the tin cylinder. In using it the lever is lifted up and the tin cylinder slipped over the wooden one; the lever is then brought down over the joint to be soldered; while the lever is held down by one hand the link is to be pressed on to the stud in front of the cylinders by the other (the distance between the lever and cylinder must be so arranged as just to nip the joint of the tin tight, when the lever is brought down and the link pressed on to the stud); the joint is now ready for being soldered. J. D.

OUR SUBSCRIBERS' NOTES AND QUERIES.

BUNSEN'S BATTERY.—Could any reader inform me by what means I could make a small Bunsen's Battery give sufficient light to read by?—R. L.

MOULDER'S GUIDE.—Can any reader tell me if there is such a book published as the "Moulder's Guide," and the name of the publisher?—A MOULDER.

SIZE OF BOILER.—I have in my possession patterns for a small horizontal steam-engine, length of stroke, 5 inches, diameter of piston, 3 inches. I wish to know the size of a boiler requisite for two of them, and if it can be procured, and where, as I intend fitting up two of them for a small locomotive?—J. L. B.

MODELS.—Can any reader tell me where I can get a set of geometrical models to order?—G. S. C. M.

HAND POWER MACHINE.—Will any correspondent furnish me with drawings of a hand-power machine for making woollen rags into woollen flocks, giving exact dimensions with figures, or is there a book in existence giving full particulars?—PHILLIP.

ELECTRIC TELEGRAPH.—Can any subscriber tell me how to make a simple electric telegraph that will transmit signs say from the top of the house to the bottom?—B. P. ELLIS.

PATENT METAL.—Can any reader tell me the material used in the manufacture of what I have heard called the patent metal or brass improved?—AMATEUR BRASS MOULDER.

SOAP MAKING.—Will any kind subscriber send me a receipt for making good common hard brown soap? I have made a small quantity but find it full of hard crystals. How can I prevent this?—ROBERT MARSH.

CYLINDER.—Will any reader inform me where I can get an oscillating cylinder, 13 inches long, 6½ inches bore, with or without an eccentric, also the price of it?—G. P. CARPENTER.

SHIPS' PUMPS.—Can any reader inform me the quantity of water pumps are capable of lifting on board such a ship as the "London?"—W. PEARSON.

REVERSING MOTION.—Can any subscriber tell me the simplest way to construct a mechanism to reverse the motion of a small horizontal steam engine, 2-inch stroke, the slide valve being at the side of the cylinder, also the mode of setting the slide valve. If illustrated with a diagram or two so much the better.—EXCHANGE.

TYING WOOD.—Can any reader inform me if there is any machine in use for firmly and quickly tying bundles of firewood? I am in the habit of having about 1,500 bundles tied every week by hand, which is a very slow job.—CHIPS.

CLEAR VARNISH FOR FRET WORK.—Can any subscriber tell me where I can procure a good varnish for delicate fret work? It is hardly safe to French polish this kind of work, and I have for a long time been searching for some varnish which will give an equally clean polish, but have not succeeded. Is there not some American composition suitable for the purpose, as I am told that French polish is not used in America?—UBIQUE.

SPECULA FOR TELESCOPE.—Can any scientific reader inform me how to cast, grind, and polish (by hand if possible) a small "Specula" for a Reflecting Telescope—say 6 inches diameter and 30 inches focus, the cheapest way, also the price of materials, and if they could be got in Manchester?—ASTRO

FURNACE CINDERS.—Can any correspondent tell me the best way to construct a machine for the purpose of neatly cleansing the waste cinders from boiler puddling or ball furnaces, so as to use the good cinders over again?—ECONOMISER.

ENGINES FOR BOAT.—Will any reader oblige me with the proportions of a small horizontal steam engine (two cylinders) to drive a small pleasure boat about fifteen feet long at the speed of eight miles per hour, screw propulsion, with diameter and pitch of propeller, size of boiler, pressure per square inch, price of boiler, turnings, and boreings?—R. T.

ASTRONOMICAL.—Can any reader give me a mathematical demonstration of the nature of the curve of aberration? I have read a little of astronomy and of the inequality which astronomers have to correct in their computations, but I have not yet met with a full explanation of the nature of the curve.—BICKERDIKE.

AIRO-HYDROGEN BLOW-PIPE.—Can any reader favour me with the directions necessary in the construction of this—the various dimensions, &c.; also, concerning the materials used for the gas generator, safety box, and other fittings?—W. T. C.

STAINING WOOD.—Can any one inform me the best way of staining walnut darker, before polishing? Some walnut veneer I have is much lighter than another lot which I require to use together.—W. A. CAMP.

REPLIES TO QUERIES.

COG-WHEELS.—Wm. Gale will find the following rule a simple and ready method to find the pitch line of cog-wheels. Suppose the number of teeth or cogs to be 96, and the pitch, 2 in. By multiplying the number of teeth by the pitch, the product will give the circumference of the wheel. Then multiply the circumference by 7, and divide the product by 22 will give the pitch circle of the wheel, thus:—

```
      96 teeth
       2 pitch of teeth.
      ---
     192
       7
     ----
22) 1344 (61 pitch circle, 5 ft. 1 in. and
    132      2/22 or bare 10th of an inch.
    ---
      24
      22
      --
       2-22
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JOSEPH STANLEY.

CLEANING BRASS.—Mr. Knight has instructed Mr. S. Stevens how to clean old brass for lacquering. I have cleaned lacquered articles, when not corroded, by boiling the articles in a mixture of bran, alum, and soap. A handful of bran, ¼ ounce each alum and soap. When clean I wipe dry and expose them to the fumes of burning sulphur.—R. ALEXANDER.

PIECING LEATHER STRAPS WITHOUT LACES.—If W. Farn (Vol. 2, No. 45,) will dissolve best gutta percha in bi-sulphide of carbon till it attains the consistency of thick glue, he will have a cement that will do excellently for straps, provided they are not subjected to such friction as will make them warm. The piecing must be nicely spliced, and made so thin at the ends that it will not catch in working; then spread as much of the cement on as will cover; allow it to stand 2 or three minutes, them warm the splicing over a fire, lay them together, and hammer or otherwise press them well. In a few mintues the piecing will be so firm as to withstand the efforts of two or three men to pull it asunder. I have pieced straps with this that have now been working two or three months at high speeds, and over small pulleys.—J. H. R.

BUNSEN'S BATTERY.—In answer to D. Eatham, I send the following method by which carbon may be prepared for Bunsen's battery. Pound together equal quantities of good pit coal and coke, press the mixture into a wrought iron mould, and subject it to a red heat in a charcoal fire for about an hour. When the mould is cold, the carbon inside will be found far too porous and soft for electrical purposes, it must, therefore, undergo further treatment by being soaked in a strong solution of molasses in water, and then be subjected to an intense white heat for several hours in a closed vessel, after which it will be found to have acquired considerable hardness; a compact texture, and to be moreover, an excellent conductor of electricity. It can then be sawn, turned, &c., to the required shape.—WILLIAM S. ANDREWS.

THANKS FOR INFORMATION.—F. G B. thanks Mr. A. Neison, ARROW, and E. L. for their replies to his queries respecting lathe motion. They have supplied him with all the information he required.

BOOK OF REFERENCE.—If Magis et Magis and Mr. William Gale get the "Elements of Mechanism," by T. Baker, C.E., which is No. 98 of Weale's Series, price 2s. 6d., they will find all they require.—DAVID KNIGHT.

CANADA BALSAM.—Micros can soften Canada balsam by spirits of turpentine, but it will not be so good for microscopical purposes.—DAVID KNIGHT.

HOW TO USE GAS AS A HEATING AGENT.—If James Robertson (January 19) will adopt the following plan he will heat his flask much cheaper and cleaner than by any other mode which has been suggested to him. Take a piece of ⅝in. brass tube, 4 in. long, bore four ⅛in. holes opposite each other, one inch from the end of the tube, place it over the gas burner, which should be a No 2 or 3 union jet, resting the tube with the holes at the lower end, on the L cock or gallery; the gas should burn blue at the top of the tube, not at the burner, and be free of smoke or soot; if the flame be white, increase the area of the holes to admit more air; the holes will require to be on a level with the top of the burners; this is well adapted for heating tea or coffee in the morning.—Can any of your numerous readers inform me how to galvanize cast metal; also, the ingredients required?—A. R., DUNDEE.

PITCH OF CIRCLES OF COG AND SPUR WHEELS.—Allow me to the best of my ability to tell Wm. Gale how to find the pitch circles of cog or spur wheels. I think it will be better that I should take an actual example, but before doing so, it is necessary that I should state clearly what is meant by "pitch circle." The pitch of a wheel is that circumference, which, when one circle drives another by rolling upon it, gives the desired velocity to the driven wheel. Thus, let there be two wheels, A and B, and let it be required that A, while turning once round in contact with B, should cause B to revolve twice. Further, let the circumference or pitch circle of the wheel A equal 3 feet; then it is evident that the circumference of B must equal the half of A's circumference or 18 inches. Under the conditions here assumed the pitch circle of wheel A, equals 3 feet,
and " " " " " B, " 18 inches.
Next, the pitch of the teeth of a wheel is so much of the pitch circle as is embraced by 1 tooth and 1 space. Thus, let the width of one tooth equal 1½ inch at the pitch circle, and the space between the teeth equal 1½ inch also; then the teeth of that wheel are said to be of 3 inch pitch. I will now give an example, which will, I hope, make all clear. It is required to find the pitch circles of two wheels of 2 inch pitch, one of 70 teeth, the other of 30 teeth. Now 70 × 2 inches = 140 inches, equal pitch circle of larger wheel, and 30 × 2 = 60 inches equal pitch circle of the smaller wheel. But it is necessary to find the radius of the pitch circles before we can actually describe them. Now in a circle the circumference = diameter × 3·1415, and of course the diameter = circumference ÷ 3·1415. Therefore, the diameter of the larger wheel = 140 ÷ 3·1415 = 44·56 inches, and the diameter of the smaller wheel equals 60 inches ÷ 3·1415 = 19·09 inches. It is perhaps needless to

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add that the teeth of a wheel are never made of the full breadth of the pitch, a 1-10th or 1-12th being allowed for clearance.—C. A. T.

LIQUID INK.—In answer to A Draughtsman upon the above, I beg to inform him that there is not a solvent for Indian Ink without impairing its qualities; I have found in practice that it is never better than when rubbed up a short time previous to using it. In answer to query No. 2, I find it is better to colour cloth tracings on the opposite side to the lines; if, however, he prefers colouring on the right side by using a little ox gall he may do it with facility, care being taken not to touch the black ink lines or they will assuredly run.—A DRAUGHTSMAN.

LIQUID INK.—The only good solvent for Indian ink is pure water. The ink should be rubbed gently in a saucer or palette containing a little water, until the required degree of blackness is obtained. It should be rubbed fresh every day for use. I have bought and used prepared liquid Indian ink, but it does not work well; you cannot make a very fine line with it, and it smudges when you colour over the lines. A little alum dissolved in the water you mix your colours with, will work better on tracing cloth than colour mixed with water only.—A. SCARGILL.

MODEL OF STEAM ENGINE.—T. H. B., Vol. ii., No. 44, can obtain a working model of a horizontal steam engine on application to S. S., 5, Tipping-square, Ardwick, Manchester.

MICROMETER.—I beg to acknowledge my very great obligation to the Fellow of the Royal Astronomical Society for his kind and courteous attention and trouble in supplying an exhaustive description of the Micrometer, and also for his generous promise to give drawings of the Equatorial Stand (the time of which shall be at his own convenience). In reference to the above stands I would solicit especial reference to the construction of the clock. I also beg to thank F. R. A. S. for the general hints and remarks which he has so kindly given, and which will be of considerable assistance to me.—J. W. B.

TURNING.—Without wishing to detract from the credit due to Mr. Joseph Peel, I must beg to assure Mr. Herbert Hurst that cutting a treble spiral ¾in. diameter, and 2ft. 8in. long, as described by him, is no very wonderful performance; neither do I consider the inventor of a contrivance for effecting this deserves such a very "valuable consideration" ere he discloses it. I see no difficulty in cutting one, half the diameter, or ten times the length of the one he mentions, either in wood or metal.—W. H. N.

LATHE MANDRIL.—Allow me to thank Mr. Pearce for his kind answer to my inquiry as to the cause of my lathe mandril heating and binding. He has rightly imagined that it is a taper mandril without a collar; at the same time I must say that I have often found lathes with mandrils, shaped as mine, work very easily.—A TURNER.

HYDROGEN GAS.—In reply to J. P. Lewis (Vol. ii., No. 45,) the simplest mode of preparing hydrogen is by sending a galvanic current through water when it suffers resolution into its two constituent gases, which may be collected separately. The method of preparing it with Woulfe's bottle is much resorted to; when it is, the zinc should be cut in small pieces, so as to quicken the evolution of the gas; the zinc and water should be introduced into the bottle by one of the necks before the exit tube is fixed in, and then add the sulphuric acid by means of the funnel. The other method you speak of is very complicated and troublesome.—J. H. RICKARD.

VARNISH.—If D. W. will add about 2 drams. mythylated spirit to 1oz. of his varnish, I think he will find the destructive properties vanish. The varnish has been made with a too strong alcohol.—AN OLD HAND.

DARK PORTRAITS.—An "Unsuccessful Amateur" must give his pictures double the exposure; and if still black, four times the exposure. The light from only one window will be very weak.—AN OLD HAND.

NEGATIVE COLLODION.—Unless A. P. is well acquainted with Chemistry, it will be much more expensive and less satisfactory to make a good negative collodion; however, he will find full instructions for its manufacture in "Hardwich's Photographic Chemistry." I can recommend the Negative Collodions of Thomas, Mawson, and Blanchard as being of first-class quality.—AN OLD HAND.

AN AMATEUR.—ELECTRO GILDING.—If we wish simply to give the gold a darker colour, the following process is said to be well adapted:—2oz. of alum, 2oz of saltpetre, and ½oz. of sal-enixum are powdered together, and placed in a pipkin with about 4oz. or 6oz. of water, and warmed over a fire; into this 1oz. of what is called gilder's wax is placed, which must be dissolved and gently simmered. The mixture must be allowed to cool, when the object is to be plunged into it two or three times and then withdrawn. The oftener the process is repeated the deeper the colour of the gold. It is then to be well rinsed in cold water and brushed with a tooth-brush. A green colour is said to be given by soft soap and alum.—T. ALLEN.

THE EXCHANGE.

MINING SPECIMENS.—I have a quantity of good specimens from the mines of Cumberland, consisting of the following:—Kidney and specular hematite iron ores, white and coloured quartz, lead and zinc ores, &c., &c. I would be glad to exchange for a few good fossils, or marine shells.—GEORGE MILNER, 17, Somerset-street, Barnsley, Yorkshire.

PHOTOGRAPHS.—I have many fine photographs, both large and small, and also many objects for the stereoscope. I shall be glad to exchange these for a good microscope. Thos. H. L., care of Editor of the ENGLISH MECHANIC.

MODELS.—I have a small working model of a steam engine, and also a model steamboat in excellent order. I am willing to exchange these for a good telescope. Address, Alpha, care of Editor of the ENGLISH MECHANIC.

SPAR.—I have some unique specimens of spar, some of exceeding beauty, I shall be happy to exchange for a small model of a screw propeller. Address, G. H., 86, Cowcross-street, E.C.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

JAMES T. B. (Greenwich.)—Write, enclosing stamed envelope, to Spon of Bucklersbury, and they will supply your wants. The back Nos. contain all you require, from the best of pens—those of thoroughly practical men.

MILLWRIGHT.—If we are not mistaken, Spon of Bucklersbury have a work—send a stamped address to them and they will forward their catalogue. If not them, try Lockwood in Stationers'-hall-court.

R. H. WILLIAMS (Cardiff).—Are you certain you have gone over the matter so fully treated on in back numbers? We fancy you will find what you require therein. If not repeat your request, and you will get an answer.

W. T. C.—Mr. Wedgwood was the first inventor. His pyrometer consists of two small cylinders of Cornwall clay, moulded into fixed sizes and baked at a low red heat. The size of these pieces is such as just to admit them between two small square brass rods, fixed on a plate of the same metal 24 inches long, ½ an inch apart at one end and ·3in. at the other. The brass rods are divided into inches and tenths, making altogether 240 divisions. On exposure to heat the clay contracts, as supposed in proportion to the temperature, and the contraction measured on the scale gave, or was supposed to give, the temperature. Morveau's improvement on this is a platinum pyrometer which measures temperature by expansion. Professor Daniell's improvement on this is a small bar of platina placed in a tube of blacklead or earthenware. The difference of the expansion between the platina bar and the tube is indicated on a circular scale. In this pyrometer, 1° of Daniell equals 7° Fahr. Your other query we have inserted elsewhere, so that you may have the benefit of the latest experiments.

A JOINER, Maidstone.—We have been disappointed by the non-arrival of the drawings, but hope to publish the engravings in a few weeks.

THOMAS DAVY.—1. You can obtain the information through Spon, Publisher, Bucklersbury. 2. We have never troubled ourselves to inquire, having always looked upon the "invention" as a piece of rank quackery.

ROYAL INSTITUTION.—Abstracts have appeared in many of the Scientific Journals. The lectures will be printed in full in the proceedings of the Institute. We intend to publish some of them.

T. P. B., Leicester.—So far as we can judge your scheme is ingenious and likely to work well.

JAS. SHARPE.—It is only a provisional protection and not likely to be carried through.

A. SCARGILL will perceive that the diameter question has been fully worked up.

JOHN FLECK, Plumber, Bedcar.—Direct to Newcastle-street, Strand, London.

DAVID KNIGHT.—It is not the fault of the type, but is caused by bad ink and bad printing; new type however is being cast and will appear in a week or two.

D. MCKELLEAR.—First procure a provisional protection, then seek an interview with the Secretary of one of the leading railways.

C. HORSTMANN.—We are glad all arrived safe, and shall expect to hear from you soon.

EXCHANGE.—We expect some drawings and shall engrave them as soon as received.

BICKERDIKE will see that his answer was forestalled.

ALFRED BLOWPIPE.—Entirely according to the metal worked up.

C. C. C.—We believe it to be a very good apparatus.

A SUBSCRIBER, Warrington.—Write to Mr. William Muir, John-street, Adelphi, London.

DONALD MCDOUGALD.—Thanks; your hints will not be lost sight of.

ROBERT HEAD.—We are informed that similar experiments are now being made.

BANTAM.—From a gum extracted mostly from potatoes.

J. S. B.—There is no law against their being run on common roads.

JAMES WHITE, Birmingham.—Search back numbers.

FASELEY.—Two editions were published, one we believe by Longman & Co., Paternoster row.

A CONSTANT READER.—Thanks; inserted this week.

BATTERSEA SILK MILLS.—We have not heard of anything similar and think that it would work well.

W. H.—Better cement the wall at once. We have tried many of the washes but have found nothing but disappointment; they do not last.

ARCHETYPE.—Write to Mr. Weale, bookseller, High Holborn, for a catalogue; also to Mr. Atchley, 106, Great Russell-street, Bloomsbury.

A. C. B.—Lockwood & Co., publishers.

J. W. BUSH.—Address, care of Groombridge & Sons, 5, Paternoster-row, London.

A YOUNG TURNER.—You had better purchase some elementary work on the subject; we should have to devote three or four pages to answer your questions in detail.

H. J. R. (Sheerness).—Your query is scarcely clear enough for us, we cannot make out what you require. Do you mean heating surface, or steam space? Repeat your query more elaborately for our next. The displacement of the hull regulates the diameter of the propeller, but the pitch is regulated by the section of the hull immersed. The deeper the immersion, the greater the friction to be overcome.

WILLIAM SMITH.—We will endeavour to do so at an early date.

M. J. G.—Many thanks for your kind interest. If we can we will answer in next; if not, your query will appear.

BIRKENHEAD.—A common rule to find the nominal horse power of a condensing engine is to divide the square of the diameter of the piston in inches by 30:—

$$\left\{ \text{Formula:—Nom. H. P.} = \frac{d^2}{30}. \right\}$$

Let the diameter be 40 inches. $\text{N. H. P.} = \frac{1600}{30} = 53{\cdot}33$ H. P.

THORNBURY.—Hemispherical ends offer twice the resistance to bursting of cylinders of equal diameters, and hence for the same pressure, require only half the thickness of metal.

CRANK (Kirkaldy).—To find the depth of crank boss in inches, multiply square of diameter of cylinder in inches by pressure of steam in lbs. per square inch, by length of crank in inches, dividing product by 1000 times the difference between the squares of the interior and exterior diameter of the crank boss. Formula.—Let p = pressure of steam in lbs. per square inch; l = length of crank in inches; D = diameter of cylinder in inches; d', d, = exterior and interior diameters of crank boss in inches; b = length of crank boss in inches.

$$b = \frac{p\,l\,D^2}{1{,}000\,(d'^2 - d^2)}$$

Let the steam pressure be 40 lbs. per square inch; length of crank, 8 inches; diameter of cylinder, 12 inches; interior diameter of crank, 3 inches; exterior ditto, 5 inches. Then—

$$b = \frac{40 \times 8 \times 144}{1{,}000\,(25 - 9)} = 3{\cdot}29 \text{ inches, nearly.}$$

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

288. Jorgen Balthazar Dalhoff, improvements in the manufacture of files by means of machinery for smoothing and cutting them.—January, 30, 1866.

289. Henry Shaw, improvements in the means and apparatus of communicating motion or power from the engine of a train to any part of the train.—Jan. 30, 1866.

291. John Garrett Tongue, improvements in obtaining motive power either giving or not giving light.—A communication.—Jan. 30, 1866.

300. William Robert Lake, improvements in working and treating india-rubber, gutta-percha, and other similar gums.—Jan. 31, 1866.

308. George Greaves, improvements in treating certain chemical matters and compounds for producing glazed surfaces.—Jan. 31, 1866.

309. Alexander Dembinsky, an improved composition for burning in lamps and otherwise the residuum therefrom being applicable for use in fireworks and for other purposes.—Jan. 31, 1866.

311. William Darlow, improvements in electro-magnetic engines for obtaining and applying motive power.—Jan. 31, 1866.

312. Hector Auguste Dufrene, an improved hydraulic steam hammer.—A communication.—Jan. 31, 1866.

318. George David Jones, a new and improved construction of pocket for male or female attire, whereby the property contained therein is rendered secure from theft or accidental loss.—Feb. 1, 1866.

319. James Bouverie Grant, improvements in apparatus or machinery for distilling and refining petroleum and other oils.—Feb. 1, 1866.

322. William Bryer Nation, improvements in the purification and hardening of paraffin wax.—Feb. 1, 1866.

324. David Winstanley, improvements in producing printing surfaces by the aid of photography.—Feb. 2, 1866.

326. Charles Herbert Holt, improvements in obtaining adhesion of the driving wheels of locomotive engines to the rails of railways.—Feb. 2, 1866.

327 William John Blinkhorn, improvements applicable to the apparatus for communicating or signalling between passengers and the guard and engine driver of railway trains.—Feb. 2, 1866.

331. George Barker, improvements in sewing machines.—Feb. 2, 1866.

337. William Mackintosh, improvements in holding details for lathes, vices, and wrenches.—A communication.—Feb. 3, 1866.

338. Albert Horwood and Charles Brumfit, improvements in galvanic batteries for keeping up constant currents of electricity for railway train signals and electric telegraphic purposes.—Feb. 3, 1866.

339. William Hibbert, an improved mechanical valve respirator.—Feb. 3, 1866.

341. John Holliday, improvements in the manufacture of red coloring matter or dye.—Feb. 3, 1866.

344. Robert Jobson, improvements in moulding articles of clay, earthenware, or porcelain, and in apparatus used therein.—Feb. 3, 1866.

346. Theophilus Alfred Gilbert Willington, improvements in apparatus for heating conservatories, apartments, or boilers by means of gas.—Feb. 3, 1866.

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LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 3RD FEBRUARY, 1866.

606. Stopping bottles, J. H. Johnson—8d.
607. Steam generators, J. H. Johnson—10d.
608. Lace, &c., H. Taylor—1s.
609. Coupling railway carriages, D. Morris, J. Morris, and J. Morris—10d.
610. Fitting sliding partitions in stables, &c., L. Le C. Cottam—8d.
612. Sheep shears, W. Clulow—10d.
613. Marine steam boilers, E. Humphreys—4d.
614. Casting steel tyres, J. Whitley—8d.
616. Shaping file and other blanks, T. Turton—10d.
617. Dyeing and preparing cotton and other warps, A. Akeroyd—4d.
620. Pumps, R. A. Brooman—4d.
621. Safes, S. Phillips, and J. Groves—4d.
622. Combing wool, &c., S. and W. Smith—1s.
623. Covered springs or skirt wire, T. S. Sperry—8d.
624. Preserving ships and other structures from corrosion, F. Cruickshank—4d.
625. Numbering machines, T. Craig and D. Carlaw—4d.
626. Buffers, W. J. Oliver—4d.
627. Scutching flax, &c., A. Potts—4d.
628. Hooping bales, W. Riddle—2s. 2d.
629. Caustic liquor, T. Nicholson—4d.
630. Manufacture of crucibles and pots, G. Nimmo—8d.
631. Preparing hides for tanning, W. Clark—4d.
632. Testing grain and seeds, W. Bunger—1s.
633. Bridges, E. W. Young—8d.
634. Tubular boilers, R. A. Brooman—10d.
635. Measuring the human body, J. H. Wilson—1s.
636. Heating, cooling, and ventilating, L. Perkins—1s. 4d.
637. Shoes, &c., A. E. A. Aubert, and G. E. M. Gerard—4d.
638. Cork-cutting machinery, W. Clark—8d.
639. Horse-shoes, W. Clark—10d.
640. Joints for boxes, drawers, &c., H. W. Wimshurst—2s.
641. Steam hammers, J. Dodge—4d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

PROPERTY RECORD.

SALES AT GARRAWAY'S.

By Messrs. BROAD, PRITCHARD, & WILTSHIRE.

Freehold six houses, in Libra-road, Old Ford, of the value of £148 4s. per annum—sold for £1,095.

Leasehold two cottages, Nos. 7 and 8, Lefebre-road, Old Ford, producing £46 16s. per annum, term 99 years from 1856, at £6 10s. per annum—£250.

Leasehold three residences, Nos. 136, 138, and 140, Church-road, De Beauvoir Town, Islington, producing £157 per annum, term 80 years from 1858, at £15 per annum—£1,790.

Leasehold two residences, Nos. 17 and 18, Seymour-place, Bryanston-square, producing £96 per annum, term 92 years from 1808, at £11 18s. per annum—£1,005.

Leasehold residence, No. 8, York-cottages, Brompton, let at £50 per annum, term 80 years from 1826, at £15 per annum—£775.

Leasehold residence, No. 3, North-terrace, Alexander-square, Brompton, let at £60 per annum, term 80 years from 1826, at £9 per annum—£680.

Leasehold house, No. 2, Stafford-street, Marylebone-road, Lisson-grove, let at £50 per annum, term 71 years from 1796, at £6 10s per annum—£100.

By Mr. JOHN DALLOR.

Freehold house and shop, with workshops, yard, &c., No. 425, Oxford-street—£2,060.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Erection of a Farm House at North Waltham, near Basingstoke, Hants.—Particulars of Mr. Clarke, Clerk of the Works, North Waltham.

Contracting with the Luton Local Board of Health, for providing and laying York paving, Denner Hill Channelling, and York Curle, and also for levelling and metalling roadways.—Particulars of Mr. Sandoe, 15, Stewart Street, Luton, Beds.

Erection of a Coastguard Station at Greencone, near Lennor, in the County of Cornwall.—Particulars at the Coastguard Office, Admiralty.

Erection of a Lunatic Asylum at the Royal Victoria Hospital at Netley, in the County of Hants.—Particulars at the War Office, Pall Mall.

Construction of about 1,000 feet run of Brick Sewers, in the Parish of Chelsea.—Particulars of Charles Lathe, Esq., Vestry Hall, Chelsea.

Supply of Materials and Execution of masons, paviors, and bricklayer's jobbing and measured work in the Parish of St. George-in-the-East.—Particulars of W. H. Howell, Vestry Hall, Back Road.

Construction of a New Wood and Brick Church at Talke, North Staffordshire, designed by G. E. Street, Esq.—Particulars at the office of Thomas Sherratt, Esq., Talke, near Kidsgrove Station, North Staffordshire.

Erection of Railway Station and other Buildings for the Directors of the London, Brighton, and South Coast Railway Company.—Particulars at the Office of Sir Chas. Fox and Son, 8, New Street, Spring Gardens.

Supply of Building Materials for Repairs of Convict Prisons.—Particulars at the Office, 45, Parliament Street, Westminster.

Apparatus and Ironwork required in the erection of New Gas Works at Hornsey, Middlesex.—Plans and Specifications at the Office of Jabez Church, C.E., 6, Martin's Lane, Cannon Street.

Alterations to Coleford Market Hall.—Particulars at the Office of Mr. W. H. Fryer, Coleford.

TENDERS SENT IN FOR BUILDING WORKS.

For additions to the Roman Catholic Diocesan Seminary, Belfast. Mr. John O'Neill, architect:—Byrne (accepted), £5,090.

For a detached residence in London-road, Enfield. Mr. T. J. Hill, architect:—Woodward, £2,300; Rivett, £2,293; Bell and Son, £2,118; Webb and Sons, £2,059; Colls and Son, £1,964; Patman, Brothers, £1,897; Fairhead, £1,876; Cushing, £1,862.

For constructing new sewer, Manor-road, Bermondsey.—Mr. George Elkington, surveyor:—Reddin, £2,480; Bloomfield, £1,750: Thackeray and Pearce, £1,595; Kelly £1,460; Kent, £1,458; Parker, £1,397.

For Primitive Methodist Chapel at Stratford-upon-Avon, Mr. Thomas T. Allen, architect.—J. and G. Calloway (accepted), £395.

For new manufactory in Drummond-road, Bermondsey, for Mr. James Peek, Messrs. Davison and Scammell, architects:—Hill and Keddell, £20,244; Brass, £19,894; Higgs, £19,544, Adamson and Sons, £19,516: Coleman, £19,450; Conder, £19,399; Gammon, £19,330; Hart, £19,120; Maeers, £19,000; Trollope, £18,943; Munday, £18,590; Browne and Robinson, £18,435; Dove, £18,430; Rider and Son, £18,160.

For erecting a pair of villas at Upper Tooting, Surrey, for Mr. Herbert W. Taylor. Messrs. Wimble and Taylor, architects:—Colls and Son, £3,374; Adamson and Son, £3,300; Perry and Co., £3,275; Marsland and Sons, £3 175; Gulland and Thompson, £2,900.

For the erection of two cottages and stables at Mortimer, Berks, for Captain Adams. Messrs. William and J. T. Brown, architects:—Sheppard, £1,136; Barnicoat, £1,063; Dodd, £1 059; Strong, £1,026.

For two detached villas for Mr. John Peache, Sevenoaks, Kent Mr. H. Cronk, architect:—Hyder, £3 555; Stevens, £3 350; Yates, £2,958; Hoadley, £2,890; Wiltshire, £2,875; Potter, £2,860.

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	96	0	0	0	0	0
Sheet	do	101	0	0	0	0	0
IRON.							
Pig in Scotland	per ton.	3	5	6	cash.		
Welsh Bars, in London	do	7	15	0	0	0	0
Wales	do	7	0	0	0	0	0
Staffordshire	do	8	10	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
LEAD.							
Pig, Foreign	per ton	20	12	6	21	0	0
Red or minium	do	22	10	0		—	
QUICKSILVER	per bottle	7	18	6	8	0	0
STEEL.							
Swedish faggot	per ton	16	0	0		—	
" Kegs	do	15	0	0		—	
TIN.							
English Block	per ton	102	0	0		—	
" Bars	do	103	0	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.		£	s.	£	s.
Teak	11	10	12	10	2nd do	12	10	14	0
Quebec, red pn.	3	5	4	15	St. Petersburg yel.	10	10	12	0
yellow pine	2	15	3	10	Finland	8	0	10	0
Memel	0	0	0	0	Memel	0	0	0	0
elm	3	10	5	0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Dantzic oak	3	10	6	0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	6
fir	2	5	3	10	Staves, per standard M.				
Memel fir	3	0	3	10	Quebec, pipe	80	0	85	0
Riga	3	5	3	10	puncheon	20	0	25	0
Swedish	2	0	2	10	Baltic crown pipe	170	0	190	0
Masts, Quebec, rd. pine	6	10	8	10					
yellow pine	5	0	6	0					
red pine	0	0	0	0					
Lathwood, Dant. fm	5	10	6	10					
St. Peter's	7	0	8	0					
Yellow Pine, per reduced C.									
Canada, 1st qual.	17	0	19	10					

MISCELLANEOUS.

	£	s.	£	s.		£	s.	£	s.
PUMICE STONE per ton	5	0	8	0	Olive, Gallipoli	56	0	0	0
OILS, &c.					Cocoanut, Coch. ton	51	0	52	0
Seal, pale pr. tun	50	0	0	0	Palm, fine	41	10	0	0
Sperm body	116	0	117	0	Linseed	36	10	0	0
Cod	51	0	0	0	Rapeseed, Eng. pale	56	0	7	0
Whale, Sth Sea pale	48	0	50	0	Cotton, seed	34	0	40	10

LONDON COAL EXCHANGE.

PRICES OF COAL PER TON.

Bate's West Hartley, 14s. 6d.; Holywell Main, 17s. 0d.; Wylam, 17s. 0d.; Shaw's Hartley, 18s. 6d.; Walls End Hetton, 18s.; Walls End South Hetton, 17s. 6d.; Walls End Hartlepool, 17s. 3d.; Walls End Heugh Hall, 16s. 9d.; Walls End East Hartlepool, 17s. 6d.; Walls End South Kelloe, 16s. 9d.; Walls End North Staffordshire, 17s.

THE REWARD OF MERIT.—It gives us pleasure to have to record that Mr. James Martin, the author of *The Screw Cutler's Guide*, and the inventor of the excellent radius gear, illustrated and described in these pages some time since, has received a first class prize—a silver medal from the prize committee of the South-East London Industrial Exhibition, recently held in the Hospital at Greenwich.

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LOCK MAKER.—Apply 106, York-road, Lambeth.

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MILK-CAN MAKER.—Apply G. and S. Burnard's, 9, Webber-street, New-cut.

HAMMERER (Metal or Silver).—Apply G. Betjemann & Sons, 36, Pentonville-road.

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TURNERS and Lads used to soft wood.—Apply 1, Appelton-place, Westmorland-road, Walworth.

WOOD TURNER.—Apply E. Samson, 7, Little Anchor-street Church-street, Shoreditch.

PRINTERS' PRESSMAN, one who has a knowledge of Main's machine. Address, Typo, 4, Gloucester-place, Upper Grange-road, Bermondsey.

JEWELLERS' ASSISTANT. Address, A. Z., 9, Upper Charles-street, E.C.

CABINET MAKER. App'y 34, Old Castle-street, Shoreditch.

CABINET MAKER (full price paid.) Apply 72, Upper Whitecross-street, St. Luke's.

IRONMONGERS' ASSISTANT. Apply to J. Samuel, Ironmonger, 8, Bowman's place, Holloway, N.

LOCKSMITH and BELLHANGER. Apply at Hepburn's, 93, Chancery-lane.

JOINER. Wages, 7d. per hour. Apply by letter to H., Post-office, corner of Drury-lane and Long acre.

ENGRAVER (Heraldic). Apply James F. Barnard, 5, Bream's-buildings, Chancery-lane.

SMITH.—Apply to D. Howard, Ironmonger, Brentford. A reference required.

BRASS FINISHER and GASFITTER. Apply at W. P. Wenham's, 81, Church-street, Croydon.

An ENGINEER to take charge of the Steam Pumps, Pipes, Dams, and other Works of the Belfast Water Commissioners. Salary, £250 per annum. Apply to the Secretary, Rosemary-street, Belfast.

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ARCHITECT'S ASSISTANT.—Well up in design. Apply to T. K., care of Mr. Woodward, Haling-road, Croydon, S.

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HIGH AND LOW PRESSURE BOILERS.—We find from the scale of premiums issued by the National Boiler Insurance Association that the rates charged for insurance increase with an increase in the pressure at which the boiler is worked. Thus a boiler, the condition of which places it in the A class, can be insured for 15s. per annum if worked at a pressure of 25lb. per square inch; if the pressure is between 25lb. and 40lb. the premium is 20s.; if between 40lb. and 60lb. it is 25s., and if the pressure is above 60lb. it is 30s. per annum.

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A CIVIL ENGINEER'S and VALUER'S Assistant desires an ENGAGEMENT at home or abroad, speaks French and German.—Address, R, S., General Post-office, Manchester.

A THOROUGH Practical ENGINEER and DRAUGHTSMAN desires an ENGAGEMENT as Assistant Manager or Foreman in a small works; no objection to go abroad.—Address, Engineer, 7, Ann's-place, Marlboro'-road, Old Kent-road, S.

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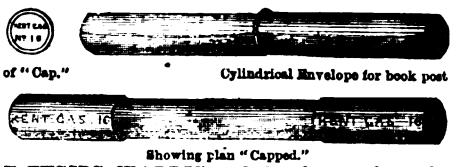

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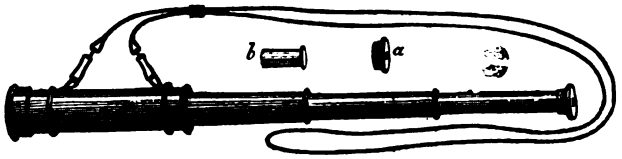

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8 "	12 "
8 "	13 "
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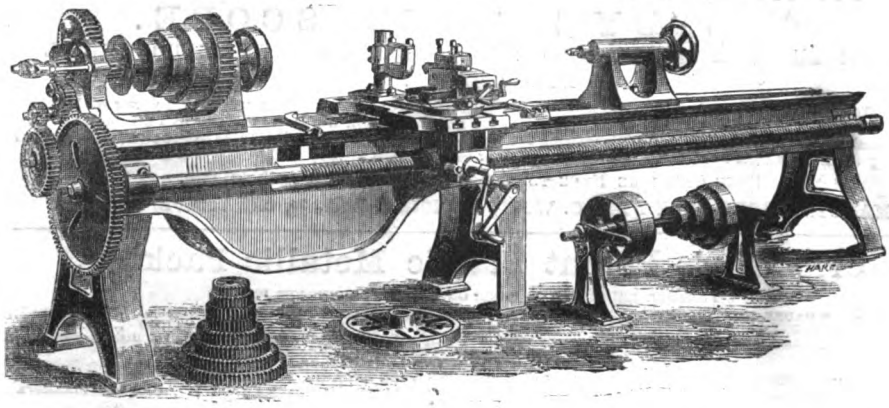
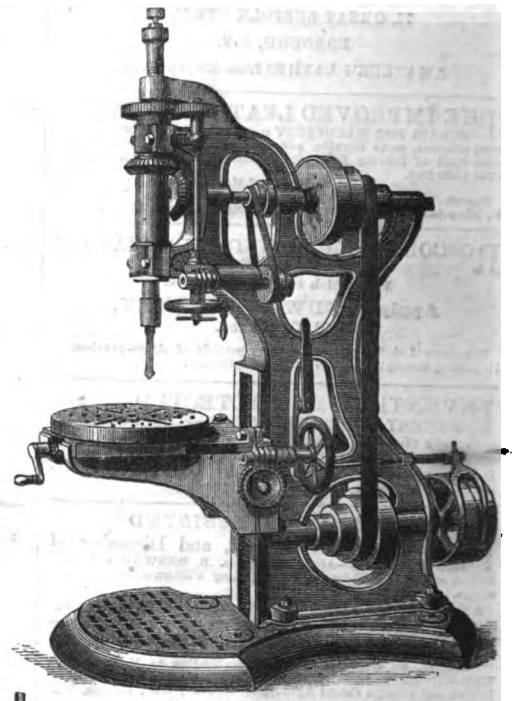
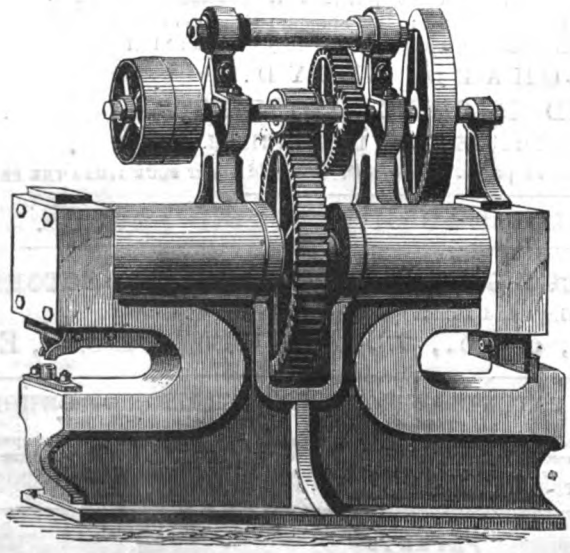
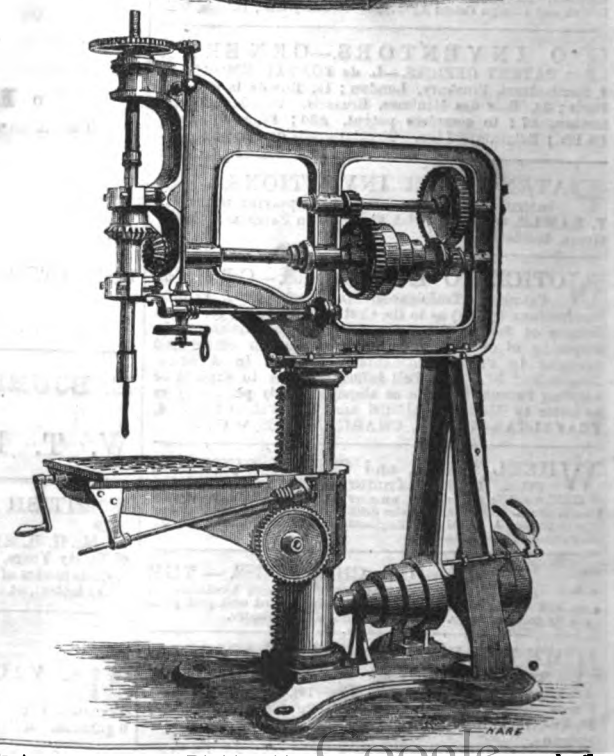
12 "	16 "
10 "	18 "
14½ "	20 "
16 "	13 "









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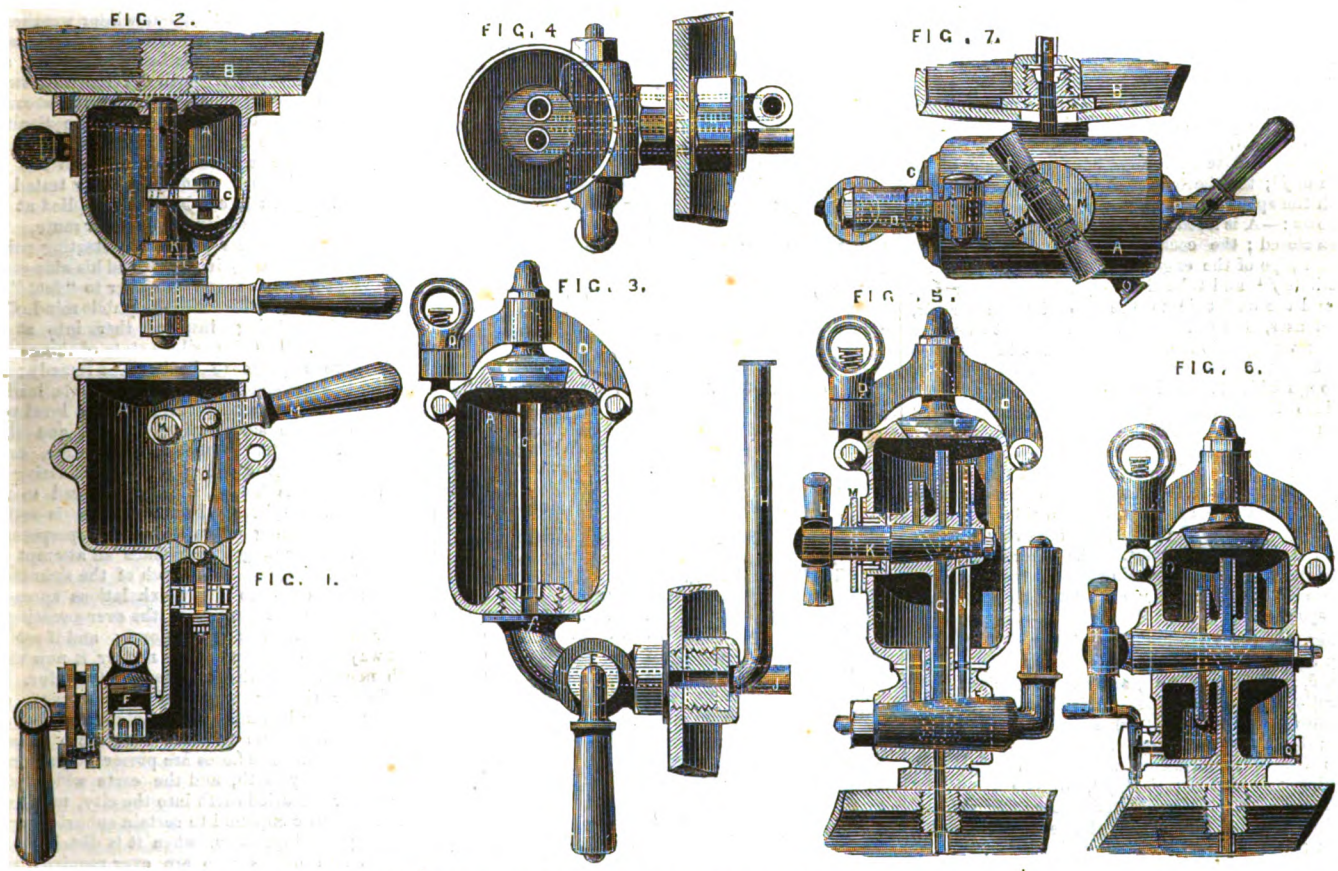
ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

A JOURNAL DEVOTED TO THE INTERESTS OF ALL CONNECTED WITH ENGINEERING, BUILDING, NEW INVENTION MANUFACTURES, METALS, PHOTOGRAPHY, CHEMISTRY, TELEGRAPHY, ASTRONOMY, ELECTRICITY, &c.

VOL. II.—No. 48.] FRIDAY, FEBRUARY 23, 1866. [PRICE TWOPENCE.



WILSON'S INJECTING LUBRICANTS INTO CYLINDERS, &c.

MR. HENRY WILSON, of Stockton-upon-Tees, has patented certain improvements in apparatus for injecting tallow or other lubricants into steam boilers, &c., and for regulating the flow thereof; which improvements, we have thought, might be interesting to many of our readers. Mr. Wilson claims injection by means of a force-pump, also by means of the gravity of condensed steam, and the means of regulating the flow. Various modes of construction are described in the patent specification; but one will here suffice. Inside a metal cylindrical vessel is cast a small force-pump, into which is inserted a hollow plunger, perforated with small holes. On the bottom of this plunger is fixed a valve of brass or of any elastic substance; to the bottom of the pump is attached a box in which is fitted a valve, and to this box a stop-cock is attached; between the stop-cock and the boiler is formed a communication, by a tube attached to each by screws and nuts. For working the pump there is fixed inside of the aforesaid vessel or reservoir a round shaft with a lever, one end of this shaft working in a bush or bearing inside the vessel, whilst the other end passes through an ordinary stuffing box to the outside of the said vessel.

In the accompanying illustrations, Fig. 1 is a section, and Fig. 2 a plan, of the apparatus for injecting the lubricant into boilers, to prevent priming or fouling. A is a reservoir; B, part of boiler to which reservoir is attached; C, force pump to reservoir; D, perforated plunger working in the pump; E, valve on bottom of plunger; F, box at bottom of pump; G, valve fixed in box F; H, stop-cock on the box; I, tube leading from stop-cock to boiler; K, shaft fixed in reservoir A, one end working in bearing J, the other passing through stuffing box L. M, lever fixed on shaft K for imparting motion, whilst the lever N is connected to the plunger D by the connecting rod O. The action is as follows:—The reservoir A is filled with the lubricating matter; the stop-cock H is then opened; the lever M is now moved up and down, imparting action to the force-pump plunger D, by which the lubricant is drawn out of the reservoir, and forced into the boiler through valve G, the stop-cock H, and the tube I.

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Fig. 3 is a section, and Fig. 4 a plan, of another form. A is a steam-tight reservoir fixed on a boiler (B); C, ordinary valve on top of reservoir, secured by screw clamp D, D; E, cock fixed in bottom of reservoir, having two parallel holes f, f^1, passing through it; G is a tube extending from the hole f into the reservoir, whilst H is a tube from the hole f into the boiler, terminating above the water line; the tube I and second hole f^1 form a communication between the boiler and bottom of reservoir. The mode of operation in this injector is as follows:—The reservoir A is filled through the upper valve C, which is then closed; the cock E is then opened, the steam passes from the boiler through the tube H, and the corresponding hole f into the tube G to the upper part of the reservoir, presses upon the lubricant, and expels it from the reservoir through the hole f^1, and the tube I into the boiler.

Fig. 5 is a section of another form of injector fixed to the steam pipe (B). A is a steam-tight reservoir; C, valve fixed on top of reservoir, and secured by the screw clamp D, D; E, cock in the bottom of the reservoir, having three holes f, f^1, f^{11}, through it; G, a tube fixed in the centre hole f^1; on the top of G is the regulator cock H, from which there are three outlets j, j^1, j^{11}, at different heights from the upper part of the cock, and converging into one hole at the bottom of the cock; the plug of the regulator cock is moved by the rod K, passing through the stuffing box X; L is the handle of the rod K; M is a sector, graduated to shew the position of the plug in the regulator cock, as shewn on Fig. 7. In the hole f^{11} in the cock E is a tube N, leading to the upper part of the reservoir, and terminating about a quarter of an inch of j^1; the bottom part of N communicates with the spout O. The mode of operation is as follows:—A is filled through the valve C, which is then closed; the cock E is now opened to the steam pipe of the engine B; the steam passes up the hole f^1 and tube G through the regulator cock H and the outlet j^1 to the top of the reservoir, condenses, and falling into the lubricant as water raises a proportionate quantity of the lubricant to the height of one or other of the tubes j, j^1, j^{11}, through which it falls into the tube G and the cock E into the steam pipe B, becomes there mixed with the steam in its passage to the pistons and valves. To ascertain when the reservoir requires refilling with the lubricant the plug of the cock E is turned to open the communication between the tube N and the spout O, if when this is opened water flows out of the spout, the reservoir requires refilling with the lubricant. The water is removed from the reservoir by turning the plug of the cock E so as to open the passage between the hole f and the spout O.

Fig. 6 shews a section of another modification of Fig. 5, in which the bottom cock E, as shewn in Fig. 5, is dispensed with, and the reservoir is fixed directly to the steam pipe. A is the reservoir; B, the steam pipe; C, inlet valve for filling the reservoir; D, D, screw clamp for securing same; G, tube for communicating with steam pipe and regulator cock H; j, j^1, j^{11}, outlets from the regulator cock; M, graduated sector; N, pointer to indicate the position of the regulator on the index; L, handle for moving the regulator; P, small cock for freeing reservoir from water; Q, screw plug for cleaning out the reservoir. The action of this injector is similar to that described in Fig. 5.

Fig. 7 shews an adaptation of Fig. 5 for locomotive engines, the side of the reservoir being attached to the smoke box, as shewn by B, whilst the tube E is attached to the steam pipe of the engine. A is the reservoir; B, the smoke box; C, the valve for filling the reservoir with the lubricant; D, D, screw toggle or clamp for securing the same; E, the tube which communicates with the reservoir and the steam pipe; P, a cock for freeing the reservoir from water; O, the spout for ascertaining when the lubricant is exhausted; L, the handle of the regulator cock; M, the graduated sector; N, the index pointer; the action of this injector is likewise similar to that described in Fig. 5.

THE ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART.

TWOPENCE WEEKLY.

No. 46, Feb. 9:—Cooper's Rolls for making American Car Axles, with a fine Engraving.—Lateral Extension.—Labour Prospects.—Accidents in Mines.—The Patent Office Enquiry and its Results.—Practical Photography, with Illustrations.—Simple Method of Holding Articles while being Drilled, with Diagram.—The Aneroid Barometer.—Fluting Mouldings.—Photographic Notes.—Analytical Chemistry.—Astronomical Notes.—Technical Chemistry.—Anthracite used as a Medicine.—Scientific News.—Progress of Invention.—Automatic Telegraphy, by Alexander Bain, Esq., with Illustrations.—The Lathe and its uses, with Illustrations.—Rotary Steam Hammer, with Illustrations.—Chuck, for Holding Wires, with Diagram.—Electro Magnetic Engine, with Diagrams.—Chuck for Screws, with Diagram.—Air Gun, with Diagram.—Letters to the Editor.—Our Subscribers' Notes and Queries.—Replies to Queries.—And many original and selected articles of value, alike to the amateur in Science and Art and the Working Mechanic.

No. 47, Feb. 16.—Messrs. Woodward's Improvements in Melting and Smelting Furnaces, with Illustrations.—Telegraphy.—Electro-Metallurgy.—A New Analine Black.—Improvements in Regulating and Working the valves of Steam Engines, with Diagram.—London Association of Foremen Engineers.—New Atmospheric Insulator, with Diagram.—Marine Engineering.—The Steam Fire Engine, with Illustrations.—The use of the Lathe, with Illustrations.—Cooling and Freezing, with Illustration.—The Original Screw Propeller.—Letters to the Editor.—Notes and Queries.—Replies to Queries.—And many original and selected articles of value, alike to the amateur in Science and Art and the Working Mechanic.

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The English Mechanic,
AND
MIRROR OF SCIENCE AND ART.

FRIDAY, FEBRUARY 23RD, 1866.

SEWAGE.

A NASTY matter to have to do with at any time, but one which must inevitably be meddled with more and more, as the subject of health of towns engrosses public attention: and that it will engross it is a certainty, so long as we are in recurring anticipation of a visit from the cholera. No doubt our sewerage works, nearly completed, are a great engineering triumph, but the statement has been put forward more than once that the greater part, looking at the purpose for which the works were designed, is a failure. The statement is put forward in this wise:—At a certain declination sewerage of a given consistency will run down hill, but the gas generated by the mass only flows up hill. When the sewage flowed into the Thames, this gas had the advantage of a large open surface of water through which to bubble and escape. Now this sewage is confined in sundry brick buildings underground, there to ferment and exhale pestiferous gases: and thus, as the filthy mixture flows down from the high grounds to these receptacles up flows the gas to Upper Clapton, Hampstead, Highgate, &c., those elevated districts acting as chimneys for the gas; and there are consumed the compounds generated from Barking out-fall upwards. In fact, it is affirmed that through every possible crack and crevice issues the poison into the roads and houses. "London," says a contemporary, "has become a huge volcano of fever-damp, more pestilent than the fire-damp of the coal mine, which slowly and insidiously is undermining the vitality of the inhabitants, and will ultimately expand into a wide-spread epidemic. It is everywhere." This is a startling announcement indeed, and deserves immediate attention. It is affirmed again that the gas is perceptible in City offices, and banks, and that wherever there is a burrow in the earth or a hollow space beneath the floors, and above the ceilings, or in the partitions, there it lies in store, "to issue forth whenever the fire burns brightly, to make us sicken and shudder."

There is no doubt that our winter weather, so far as it has gone, is favourable to the development of cholera, the ingredients being at present, as it were, "held in solution" until developed by two or three hot, close days. The statements above recorded demand the attention of the Sanitary Inspectors and the Board of Works: in short, the matter should be seen to at once. And the test is a very simple one. A mine is easily tested for fire-damp. The test can be easily applied at any spot on the higher portion of the sewer route. The "City and bank offices" offer ready starting points; and our excellent City inspector and his aids can go to work at a very cheap rate either to "fact" the statements made or disabuse the public mind of the apprehensions being instilled there into at the present time. If this perilous state of things does exist there appears to be but one remedy; and that is, to erect shafts at certain intervals, leading from the sewers to a height at least on a level with the tops of the surrounding houses, and there creating a draught by means of furnaces, or by some other means drawing off and rendering the gases innocuous before they are allowed to mix with the atmosphere. Public opinion is setting against the feeding of cattle on soil perpetually irrigated with sewage, ever since an attempt was made to demonstrate that much of the sickness of Edinburgh is due to filthy exhalations spread at intervals over the town from the ever-sweating, if celebrated, Craigentinny Meadows; and if setting that way as to one part of the matter, it now views with more favour the schemes of the Rev. Mr. Moule for ridding towns of their sewage, and leaving a profit behind. The whole of the reverend gentleman's scheme resolves itself into a very simple matter. The fæces are preserved inodorous by means of dry earth, and the carts which bring in coals or the dried earth into the city, take away the inodorous compound to certain suburban spots or sewage head quarters, when it is distributed to farmers and others who are ever requiring such aids to vegetation. To this matter we may return at an early date; but we cannot too strongly impress on our readers the necessity for a stir in the matter, however disagreeable may be the result thereof.

SEAHAM HARBOUR BLAST-FURNACES.—A prospectus has been issued of the East Rosedale Iron Company (Limited), with a capital of £100,000, in 5,000 shares of £20 each, and it is not anticipated that more than £10 per share will be required. The company has been formed for the purpose of purchasing the works upon and leases of, certain estates in the parish of Hinderwell, in the North Riding of York, containing an area of about 300 acres. The property abounds in ironstone of a superior quality, besides a valuable seam of jet rock, about 18 feet in thickness, from which oil of a valuable character has been extracted.

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THE ART OF COINING.

I.

AT a very early period in the history of most nations it was found necessary to introduce some mode of representing property in a concentrated form. This was effected originally in our own country in a very rude manner, and until the invasion of Britain by the Romans, what was called money consisted principally of rings of iron and brass. Many specimens of these primitive coinages are still extant, and the numismatic student may satisfy himself of the fact by visiting the department of the British Museum devoted to coins. It is not essential however to our present purpose to dwell upon the modes of coining as practised by our remote ancestors. By so doing we should convert what is intended to be a series of practical papers on the art of coining into a long archæological dissertation on money, and money making—a course at once inappropriate and inconvenient. Coining, like almost all other arts and processes, has passed through a great variety of mutations, until it has arrived in most civilised countries, and especially in our own, at a stage which approaches perfection. From the rude and barbarous mode of cutting pieces of metal of various kinds into portable shape, and stamping them by hand power with an impress, inartistic and inelegant, coins have come to be produced rapidly by admirable steam-driven machinery, to be regarded as works of art, and to remain as permanent historical records of the nations which they pertain.

There existed for many centuries in England a considerable number of provincial mints—as, for example, in Winchester, Canterbury, York, and other places. Some of these were entirely under the control of the monarchs in whose reigns they were established, whilst others were devoted to the service of dignitaries of the Church, or nobles who had gained the special favour of the king. It was not an uncommon thing either, for the royal or prelatical money makers of early times to have among their retainers a number of followers whose duty it was to accompany their masters in their journeys from place to place, to carry with them their coining appliances, and when, the supply of coin failed, to set to work and replenish the exhausted finances of those who employed them. These men were distinguished by the appellation of 'moneyzers.' Hence we find pieces of money bearing the names of obscure and remote places where no mint ever existed permanently, and which had simply been visited by peripatetic coiners who were compelled to give guarantees for the genuineness of their wares, and to stamp upon them their own initials, and the names of the localities where they were produced. Up to the period of Charles I. the art of engraving devices on steel for the purpose of imprinting coins had made but little progress, but the coins of that unhappy monarch, those of the Commonwealth, and of Charles II., are distinguished by enrichments of design, and excellence of workmanship which reflect the highest credit upon Simon, who was then the national die engraver. In fact, it is questionable whether the works of this artist have been surpassed by any die engravers since, scarcely excepting Andre, who executed some admirable medal dies for the Emperor Napoleon I.

It has been the habit of historians to depreciate and to denounce Queen Mary, and probably there exist many sufficient reasons for that course. It is refreshing to be able to say something in favour of her much-abused Majesty, and fortunately we are able to do so in regard to her attention to the metallic currency of the country. This was a subject which deeply interested her, and in her reign efforts were successfully made to increase its purity and to prevent the nefarious practices of counterfeit coiners. One great feature in the annals of the British coinage is the concentration of all the provincial mints into one metropolitan establishment, and it is believed that the proposition emanated directly from Queen Mary. At all events, the reformation was effected during her occupation of the throne, and thenceforth, up to the year 1787 all of the coins of the realm were struck within the walls of the Tower of London. It must be admitted, nevertheless, that by the year just named the subsidiary or copper coinage of the United Kingdom had become deteriorated to a very serious extent, and it is on authentic record that fully half of it then consisted of spurious pieces of money manufactured in Birmingham. It was about this period, indeed, when the celebrated Matthew Boulton, of Soho, directed the attention of the Government to this evil and finally received orders from it to supplement the exertions of the Royal Mint by the fabrication of a totally new coinage of copper in very large quantities.

In 1788 Boulton completed his coining machinery, the first which was ever propelled by steam power, and very soon demonstrated the advantage of such an arrangement by the rapid production of many thousands of tons of pence, halfpence, and farthings. Other orders followed, and many foreign states availing themselves of the existence of the Soho mint, had their coins manufactured by Messrs. Boulton and Watt. It was in the year 1806 that the question of enlarging the national money factory and applying steam power to its machinery came prominently before Parliament, and, after some discussion, it was determined to erect a totally new mint without the Tower of London. Money was voted for the purpose, and the site of an old building, hitherto used as a victualling office and tobacco store for the navy, was selected as the position most eligible for the purpose. Some property adjoining was purchased, and the whole then pulled down. Thus an area of some six acres of ground was obtained, and with Smirke for its architect, Boulton and Watt as its engineers and machinists, and John Rennie as its millwright, the present noble edifice, with all its equipments complete, came into existence in 1810.

The first coinage produced at the Royal Mint was one of quarter anna pieces (of copper) for the East India Company, as an experimental testing of the steam machinery. Several of Boulton's mechanics, who had gained their coining experience at Soho, were transferred to Tower Hill, and these quickly ensured the smooth and efficient working of the mills, presses, and other machines, and instructed the moneyers and labourers in the various manipulative processes connected with the new order of things.

It is unnecessary to trace the history of the mint from its formation to the present time, but it may be well to mention the fact, that up to the year 1851 a corporate body, known as the Company of Moneyers, ruled supreme within the coining department of the establishment. They professed to have a patent right to fabricate the gold and silver coins of this country, and to contract with the existing government for the privilege of doing so. They traced or endeavoured to trace their descent from the moneyers of the Saxon Heptarchy and to prove that Charles II. confirmed their charter of rights. A royal commission, however, at the head of which was Richard Lalor Sheil, then Master of the Mint, disposed of the claims of the Company of Moneyers, comprising at that time five members and two apprentices, and they were removed from their posts, receiving handsome pensions for loss of office. The mint then became an exclusively governmental establishment, its first master under this phase being Sir John Herschell, who in contradistinction to the old practice of making the post a ministerial one, was appointed for life. In the reorganization of the establishment which followed, it is but scant justice to Captain (now Colonel) Harness, R.E., to mention that he, as Deputy Master, largely assisted Sir John Herschell. The latter grew tired of his office in 1855 (although the salary attaching to it was £1,500 per annum), and was succeeded by Professor Graham, the celebrated chemist, who still holds the position of Master of the Mint. Let us now pass through the portals of the money making establishment which, as our readers know, is situated a short distance to the east of the Tower of London, to which it presents a handsome façade. Entering the principal building we find on the right, the central office of receipt and delivery. This is fitted with scales and other appurtenances, and in it, all transactions with its sister the Bank of England take place. Ingots of gold from the cellars of the latter place, on their arrival by common stage waggon (unguarded save by bank porters) at the mint, are assayed in this office, and carefully weighed in the presence of officials connected with both places. Receipts are then given for the precious material, and it is ready for transference to the coining department. Silver is received at the same office, but except when it comes from the bank in the form of worn coins, it is purchased from bullion dealers by the Master of the Mint. The coarser materials, making the composition known as bronze, are also bought by the same officer, and afterwards incorporated in the operative department.

This *en passant*, but possibly it will facilitate the explanations of the art of coining which are to follow, if we confine our attention mainly to the production of sovereigns and half-sovereigns, incidentally, only referring to coins of silver and of bronze.

An "importation" of gold, as it is technically termed, both at the mint and bank, consists of 100 ingots,* and that is the quantity usually despatched on any one day to the former place, although in seasons of panic and pressure double importations have been sent in, and a like amount in the shape of coin returned in twelve hours. Let us suppose that an "importation" has arrived at the mint, that it has been assayed, weighed, and "passed" then its next stage of progress will be to the melting house. This occupies the left side of a quadrangle in the rear of the central office, a tramway leading to its door. Down the tramway the laden trucks are safely and steadily guided by the brawny arms of a staff of melters. The ingots dislodged from their temporary resting place are passed through the scales of the officer of meltings, who has also received a "report" as to the quality of each ingot, and knows therefore the amount of alloy to be added for reducing them to standard, or 22 carat gold. The alloy consists of the purest copper which has been found to produce a harder metal when mingled with fine gold than any other known alloy. Having determined these points the officer delivers over both ingots and alloy to his workmen for deposition in the crucibles, and conversion into a fluid state.

There are seven gold melting furnaces in the mint, and perhaps they cannot be better described to our readers than by stating that both furnaces and crucibles resemble very closely those of an ordinary brass foundry. The furnaces are arranged in a line under arched recesses communicating by means of flues with the chimney, which thus carries off the vapours from the burning coke below. The crucibles are allowed to arrive at a dull red heat before being charged with ingots and alloy, and they are then covered by muffles and lids.

Leaving them for the time, let us examine the further arrangements of the gold melting house. These mainly consist of moulds, cold water cisterns, and iron-covered tables. The first are for the reception of the rich molten compound, and they are composed of a number of bars of cast iron, about 26 inches in length, placed vertically on a frame, and bolted firmly together by means of set screws. An end section of each bar resembles the letter T so that three of them placed beside each other form two moulds, but at least a dozen of them are so placed in practice, thus forming a series or set. The frame which supports each set of moulds is mounted on wheels which run over a miniature railway directly in front of the line of furnaces. Thus it will be seen that all is arranged for convenience and for the transformation of ingots into bars of gold.

TITANIC IRONSAND.—It may interest some of our readers to know that many thousand tons of titanic ironsand are now to be had at a Spanish port within 1,800 miles of London. A sample of the sand has been forwarded to our office, and appears to be of excellent quality.

* An ingot of gold is eight inches in length, three inches in width, one inch in thickness; its weight is 200 ounces, and its value £800.

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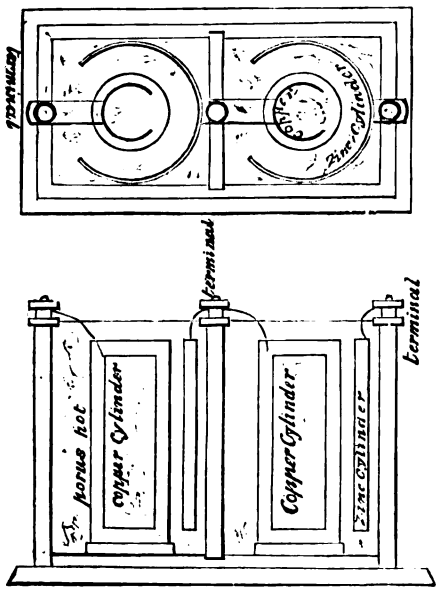


Fig.

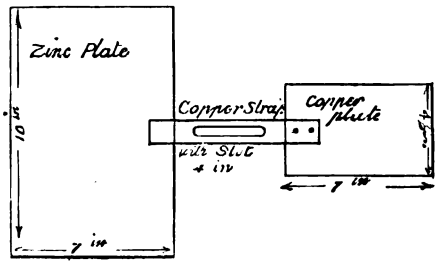


Fig. 2

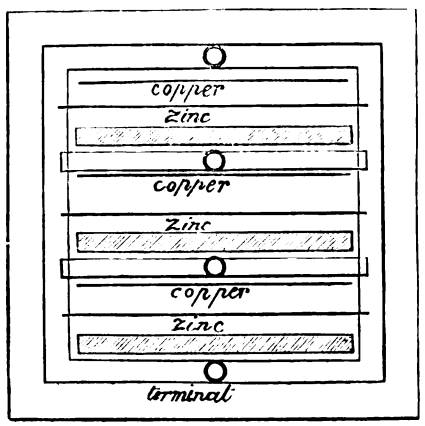


Fig. 3.

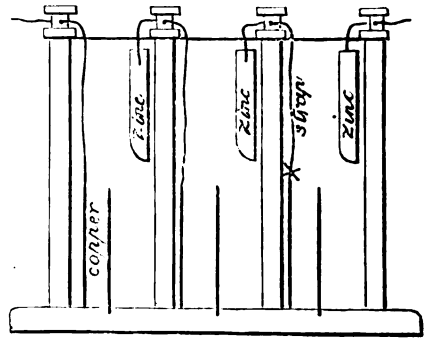


Fig. 4.

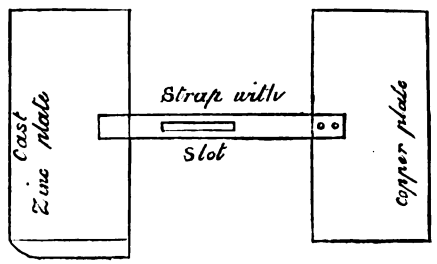


Fig. 5.

Figs. 1 and 2, Daniell's Battery slight'y modified; Figs. 3, 4, 5, Fuller's modification of Daniell's Battery

ELECTRO-METALLURGY.

THE description of the above sketches will be found in Nos. 43 and 44. Substituting however following paragraph for that commencing 8th line, page 288, which should read thus:—"A copper strap is probably the best, joins the left-hand terminal to the nearest copper, another strap the nearest zinc to the next copper, and a third strap, the second zinc to the right-hand terminal."

The management of these batteries will be found very simple with a little practice. You may take it as a rule that when three ounces of copper have been deposited, the solution in the zinc cell should be syringed out, and water be placed instead. As the crystals of sulphate of copper dissolve add more; in short, keep the porous pot always within ⅛in. of full. When the battery has been hard at work for some hours, it will be found that the solution in the porous pot has risen from half an inch below the edge to overflowing; it does no harm, but as the zinc solution sinks in a corresponding degree, fill it up with water to within half an inch of the rim of the porous pot.

In charging Fuller's battery arrange the plates first, and then fill the cell containing the copper plate with crystals of copper, and fully saturated solution of copper. Do not let any stray into the cell under the zinc plate, as it will only be wasted.

A froth collects on the surface of this battery, which may be removed with a card, and it can then be seen how much of the salt has dissolved. When a quarter only remains, syringe the sulphate of zinc solution off to the level of the copper plate, re-charge with crystals of copper and fill up with water. It is not advisable to add crystals to this battery without removing the upper solution first.

It will not appear evident to all why, if one cell be sufficient, I say construct two or three. It is that in plating two or three cells are sometimes necessary. Again in typing the cell in use may fail; then the adjoining one is ready for use without delay, and for other reasons to be explained.

From end to end of the precipitating trough stretch two copper wires about No. 10 gauge, and solder a terminal on each. Having connected the poles of the battery to them, and filled the trough with a fully saturated solution of sulphate of copper, filtered through blotting paper or flannel, hang a sheet of copper on the wire in connection with the copper plate battery and moulds, by wires and hooks to the other. MOMUS.

ON TIMBER SUITABLE FOR BUILDING PURPOSES.—I.

At the annual meeting of the Northern Architectual Association, held on the 23rd ult., the president, Mr. J. Green, Newcastle, read an address on timber suitable for building purposes. In the course of it he said—Without entering into a discussion of the anatomy and physiology of trees and the properties that will hence result to the timber of each class or natural order, I intend to confine my remarks to topics of a strictly practical character. In the first place, I will offer some remarks on the timber of those trees which have the medullary rays in their composition; after which, proceed to make some remarks upon the timber of those trees in which the medullary rays are absent. The timber of the trees in the first of the classes into which I have divided my subject, constitutes that which is generally and popularly known as hard wood, and of which the oak, the ash, the elm, and the European or Spanish chestnut may be considered as the principal types. That in the second of the above referred to classification is the timber of the *coniferæ* or resinous woods; and as examples the Scotch fir, the Tyrolese pine, the white or Weymouth pine, the pitch pine, the Norway spruce, the larch, &c., may be pointed to. It may now be remarked that, in comparing the nature of the timber required for the purposes of domestic architecture under different circumstances—as, for instance, previous to and during the Tudor period, and of that required during the present time—we find a marked and important difference to exist. The resinous wood of the coniferous trees composing the immense pine forests of Northern Germany, Russia, Norway, and Sweden, whilst admirably adapted to the roof trusses and floor joists of the stone and brick buildings of the present day, would be ill-suited to the framed erections of from 300 to 400 years ago. Besides the risk of fire that would have attended the use of fir timber in such edifices, it would have been wholly unfit for the system of carpentry which then prevailed. The use of pins and treenails, as fastenings, would split fir, whilst such fastenings are the best that could be used in the oak carpentry of our ancestors. The reason of such immunity from splitting by such fastenings in the Mediæval system of carpentry alluded to is, the binding of the yearly increase by annular additions to the size of the timber by the medullary rays of the hard wood then used, which is wholly wanting in the timber of trees of the pine tribe used in the system of carpentry of the present time. Here then, by an altered and much-improved system of house carpentry at the present day, has opened to us the use of the *Pinus sylvestris*, which, when grown on the strong soils, and in the cool climate of the northern countries of Europe, is by far the strongest, the stiffest, the most durable timber for edifices erected according to the mode of building of the present day, at a most reasonable cost. Although this is decidedly by far the best variety of pine for building timber when grown under favourable circumstances for producing good quality, yet there are many other varieties indigenous to different countries and climates, which, although not so valuable for main timber or carpenter work, are better adapted for the inside fittings, or the joiner-work of houses. The varieties to which reference is now made are the white or Weymouth pine, and the yellow pine, both from America. The Norway spruce, or *Pinus abies*, from which the white Norway battens are sawn, and also larch, make excellent flooring-boards and tread boards for stairs. Larch is also excellent for framed work, such as doors, panelling, and the like; but is too resilient for beams, or for any purpose subject to cross strain, without allowing a much greater scantling than would be necessary for the best fir, or for well grown and well seasoned oak. Of domestic grown timber suitable for house carpentry the catalogue is certainly a short one. It comprises but three descriptions of hard wood, and perhaps a fourth, if elm be included, and but two of the timber of the coniferæ. The two varieties of oak which are indigenous to Britain are the *Quercus robur* and the *Quercus sissiliflora*. The heartwood of these varieties of the oak, when the tree is well matured, is unquestionably the very best, all properties considered, of any British-grown timber. It is, however, becoming scarce, and timber of good quality of these varieties is so much in demand for shipbuilding as seldom to be available for house-carpentry, except at a very high price. In speaking of these varieties of oak timber for the purpose of house-carpentry, it must be borne in mind, that when the timber is young, it must not be considered better than, if so good as, red fir from the Baltic ports, or from Norway, or from Sweden. The hard-wood timber of home growth next in importance to the oak, is the European or Spanish chestnut, *Castanea*. This timber is as durable as either variety of oak just mentioned, and, in general appearance, it bears a strong resemblance to the *Quercus sissiliflora*, but it is inferior in strength to British oak.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

ON Saturday, the 3rd instant, the ordinary monthly meeting of this Society took place in Doctor's Commons, City. Mr. Joseph Newton filled the chair, and a numerous body of members was present on the occasion. After certain routine duties had been performed, and several new members elected, Mr. John Briggs proceeded to read a paper on the question, "Does wrought-iron become crystalline from the effects of vibration?" Mr. Briggs said he had been induced to introduce this subject for two reasons:—First, because in this iron age it is an important one, and secondly, it has never yet been satisfactorily answered. It was well-known that wrought iron frequently snapped asunder, without giving the slightest warning, and always presented a crystalline fracture. This was exemplified in the breaking of chain slings, hammers, smiths' tools, axles of different vehicles on the common road, and, lastly, in the breaking of railway axles by which so many lives have been sacrificed. They would agree with him that the importance which attached to this subject rendered it desirable that the question should be examined, both scientifically and practically, in order to determine if possible whether wrought iron becomes changed from the fibrous to the crystalline state, either by continuous vibration, or by some other agency as yet unexplained. He doubted if there existed any member of that Association who was not familiar with fractures such as he had named, and who had not noticed the crystalline appearance referred to. Most probably all had in such cases given their verdict against the quality of the iron, saying, "what a bad piece of iron; why it is as granulated as cast-iron," or "it is as brittle as glass," or, at any rate, some emphatic expression signifying its inferiority.

He thought that the first thing which called public attention to this subject, was the breaking of railway axles, for he found upon reference to the *Practical Mechanic's Journal* of June, 1842, that at a meeting of the British Association held at Manchester, Professor Vignolles, in speaking of railway axles, and referring to an accident of this kind on the Paris and Versailles Railway, stated that the French engineers in their Report had remarked that "the fractures of the broken axles, instead of having the fibrous appearance of wrought iron, presented the crystalline appearance of cast-iron." This they attributed to a magnetic or electric action induced by friction in the bearings, and which changed the molecular structure of the iron. Professor Vignolles further thought that there was much truth in their opinions, and that probably continual strains and percussions accounted for such changes in the texture of the iron. Messrs. Hodgkinson, Fairbairn, and Nasmyth, joined in the discussion which followed the paper, and on the Monday following the subject was resumed by Mr. Nasmyth, who said he had noticed in his previous observations, the effect of cold swaging, and would take the practical workman's view of the case, and not run after the *ignis fatuus* of electricity or galvanism in search of a cause. Swaging of iron, he said, produced a beautiful appearance outside, such as workmen like to see, but he had seen a piece of iron thus treated broken by a single blow upon an anvil; and although the iron was originally tough and fibrous, it then exhibited a clearly crystalline fracture. Professor Willis, Messrs. Fairbairn, Worthington, Mallet, and others, took part in the same discussion.

The subject was revived in Oct., 1843, before the Institution of Civil Engineers, by Mr. Charles Hood, who read a paper on the changes induced in the structure of iron subsequent to its manufacture. He began by calling the attention of the meeting to the important purposes to which iron is applied, his object being to point out some of the peculiarities in the habitudes of iron, which appeared almost wholly to have escaped the attention of scientific men, and which, although in some degree known to practical mechanics, have generally been considered by them as isolated facts and were not regarded as the results of a general and important law. He (Mr. Hood) then referred to the accident on the Paris and Versailles Railway before mentioned, and said he believed that the broken axles although presenting such decisive evidence of brittleness and cold short quality, were at no distant period tough and fibrous in the highest degree, and that the principal causes which produced this change were percussion, heat, and magnetism. He coincided with Mr. Nasmyth in the opinion that hammering iron when cold caused it to become crystallized and extremely brittle, so much so that if the bar were allowed to fall to the ground it broke in pieces. Another fact which confirmed generally these opinions was to be found. Mr. Charles Manby had informed him that a small bar of good tough iron was suspended and struck continually with small hand-hammers to keep up a constant vibration. This bar became so extremely brittle (after some considerable time hammering) that it entirely fell to pieces under the light blows of the hand-hammers, presenting throughout its structure a highly crystallized appearance.

From these brief extracts it seemed clear that the prevailing idea at that time was that wrought iron became crystalline from the effects of continuous vibration, and no doubt there were many adherents to this view at the present time. In the *Engineer* of a few weeks since, there had appeared an account of a coroner's inquest held near Bristol in consequence of a fatal boiler explosion. The Editor remarked that a witness showed himself to be an adherent to the time-worn and ridiculous theory of the so called crystallization of iron, because that witness stated that the iron of the boiler appeared to be slightly crystallized, perhaps from constant usage. Vibration sometimes crystallized iron, as in the axle of a cart-wheel, the iron instead of being fibrous becoming crystallized and brittle. Taking the *Engineer* as an authority, it would appear that differences of opinion still exist, but the nature of the prevailing opinon he was not prepared to state. He should, therefore, leave the question in their hands, hoping that all who had witnessed during their practical experience any of the facts already mentioned would express their views freely and without reserve, in order to expedite a satisfactory solution of the question he had very imperfectly mooted.

An animated disscussion followed — at once terse, practical, and instructive, and this was shared in by Messrs. Stabler, Jervine, Haughton, Hedley, Taylor, M. Jones, the Chairman, and others. At 11 p.m. the members separated.

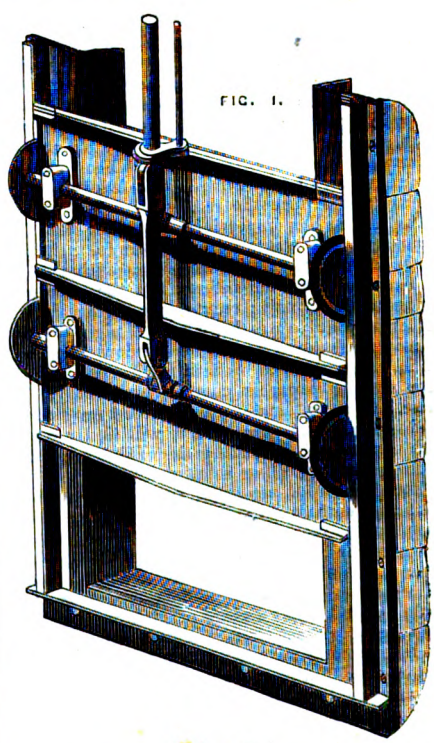
ACTION OF LIGHT ON NAPHTHALINE.

WE mentioned lately that a German chemist has found the yellow substance known as graphitic acid, obtained by the prolonged action of nitric acid on graphite (plumbago), to be very sensitive to light (vide ENGLISH MECHANIC, Feb. 9th). Since then Dr. Phipson has discovered that Naphthaline, a substance containing no less than 93·75 per cent. of *carbon*, is also acted upon by the light of the sun. Some pure white Naphthaline, placed in white flasks on the shelves of his laboratory where the rays of the sun found their way during a portion of the day, became quite brown in the course of a few weeks. One of these samples was commercial Naphthaline, the other specimen was prepared by Dr. Phipson himself, and both are supposed to be pure. It is therefore possible that this substance may some day be utilised in producing carbon photographs, or proofs of which the image will be formed of a compound, consisting almost entirely of carbon. The author of this observation remarks that he has often witnessed this coloration of Naphthaline enclosed in stoppered bottles exposed to the light, though our works on chemistry make no mention of it, and that he has not found the same to occur with paraffin, another similar hydrocarbon.

The operative engineers of Hull, are at variance with their employers who refuse an advance of wages. We trust that before the MECHANIC reaches the hands of our subscribers the dispute may have been amicably arranged.

VALVES FOR DOCKS, &c.

OUR attention has been drawn to the improvements in valves by Mr. Meyer. It consists in transforming the sliding into a rolling motion, saving thereby much of the power spent in opening or closing a valve; also, where time is of consequence, it allows the valves to be constructed of larger dimensions than heretofore without necessitating extra strong lifting machinery. Two axles, with proper bearings and plummer blocks, are fixed on the pressure side of the moving slide. The ends of the axles are turned to fit the wheels, so as to form eccentrics to the bearings of the axles. A lever is fixed in the centre of each axle, and both are connected to the slide-rod of the valve by means of a connecting rod. Supposing the valve to be closed and required to be opened: by giving motion to the slide-rod it will cause the eccentric axles to make a quarter turn, thus forcing the wheels against the rails on the stationary frame of the valve, and consequently relieving the faces of the moving slide from contact with the faces on the stationary frame of the valve. If then, the motion of the slide-rod be continued, the moving slide, with the pressure of the water against it, will travel upwards on the axles and wheels until the water passage is clear. The proportion of the reduction of friction is as the diameter of the eccentric axles is to the diameter of the wheels. Thus, if the axles be 2 inches and the wheels 20 inches diameter the friction is reduced to one tenth, and the power to open or shut the valve in proportion. As the faces on the stationary frame of the valve are left as they come from the foundry, the expense of planing, &c., is saved; on the face side of the moving slide recesses are cast, which are filled up with oak or elm wood, planed by the carpenter's plane; so that the extra cost of axles and wheels is compensated for.



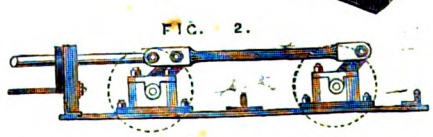


Fig. 1 represents the valve partly open and in motion; and Fig. 2, the valve shut, the guide and wheels on one side removed to show the ends of the axles.

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PRACTICAL PHOTOGRAPHY.—VIII.

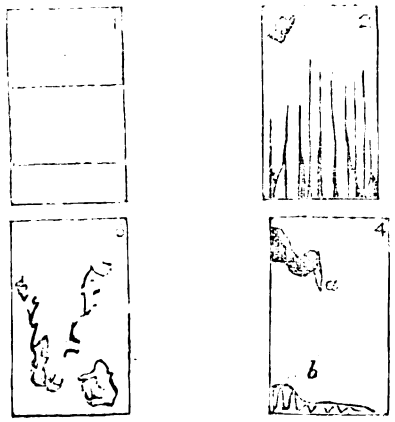
THE preparation of a dry plate requires some little dexterity of manipulation. An ordinary plate, as taken from the bath, may be carried to a considerable distance exposed, and afterwards developed with iron in the usual way, provided the weather is not too warm. Occasionally in the developing a deposit is thrown down, but if it should so occur and happen on those parts which will come out as deep shades, it will not interfere, if the plate is dried, and the deposit removed with a soft brush. Next in order for simplicity may be considered perhaps the malt or the tanin processes. The latter requires less time to prepare than the former. The plates may well be prepared overnight. To make sure, even with a small picture, coat the glass first with gelatine. Be careful in washing the plate. If you take it from the bath, and place it in a flat tray to get rid of the free nitrate, unless you have a plentiful supply of water going, you will in a few minutes probably perceive a rapid decomposition proceeding:—the plate and the liquid in the dish rapidly become a deep reddish-brown. The same effect will be produced by using the dish a second time without thoroughly washing it. The plate, of course, is useless. Wherever you see a red mark or streak on the plate, you may look forward to that portion printing out a blank white. With a dry tanin plate you may frequently see the whole picture before developing. It has the appearance of a soft picture drawn with lead pencil. This depends on the length of the exposure and quality of the sight. However pleasant such an apparition may be it will soon occur to you. What are you to do with it? Of course, the object will be to intensify rather than to develope: mix the silver solution with pyrogallic accordingly. A dry plate has frequently a violet appearance when finished, and the print from it, though very true, will be hard: which may be traced to the character of the water employed. The waste washings, containing free nitrate, you throw into some receptacle for the purpose, adding salt occasionally. You can easily fit up a box for the dry plates—any box a little wider than the size of the glass paint it black inside, fix in strips of notched wood to hold the plates, glue some velvet over the lock, and a narrow strip round the edge of the box when open, so that after shutting and locking a few times the pressure will reduce the thickness of the velvet, and make the box impervious to the light. The preparing of dry plates and of papers for printing may be carried on at the same time with care, if you have room, as the intervals in the processes may be made to suit; only remembering that if you leave your papers hanging all night to dry you may inadvertently open the window next day, and in a few minutes spoil them all. The preparation of the paper is comparatively easy. Of course, the argentometer can be used only when the silver solution is pure. You will find a bottle brush most useful for taking the oxidation off the bottles containing silver solution, but do not use the same brush for any other bottles except those which have contained like mixtures. After fixing your prints you may require something to contain the water for washing out the hypo-fixing. An oyster barrel will do exactly if bound with hoops, and sweet. Bore a small hole where the tap should be, and insert a piece of glass tube, having a wooden plug; set this on a stool out of doors, or where running water will not matter; put your print in a shallow plate; place it under the plug, and arrange that it may just drip, drip, drip away all night. The oyster barrel will contain enough water to suffice. In the books I have before alluded to you will find every information on these subjects, which it would be impossible for me to give in these chapters of hints, but there are four common defects which I notice in passing.

DEFECTS.

1. Fine lines across the plate. Reason:—You paused when placing it in the bath.

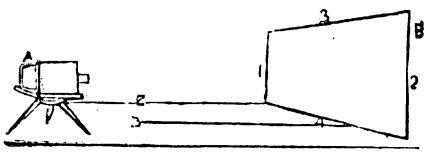
2. Either want of acid in the bath or the bath has been in use some time; if so, purify. If new, however, try another plate, letting it stay in a little longer.

3. Delay in developing, if not from carelessness, or want of alcohol in iron developer, or bad collodion.

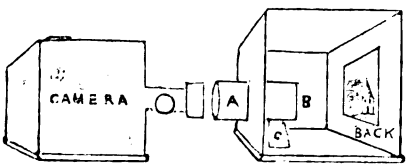


4. In dry plate either (*a*) a decomposed patch which occurred in the preparing, or (*b*) an edge not touched by the developer.

Do not attempt to take the inside of buildings at first, but when you do, observe that stone-work, painting, &c., may be beautifully delineated, whilst the patterns of windows or even the frame-work will be entirely lost from the over exposure. On the other hand, the window patterns may be secured but the interior generally be weak and gloomy. To secure a roofing or other dark part, some assistance may be obtained by placing a reflector or moderately sized looking-glass, so as during the exposure to throw the reflected light strongly and easily over the whole of the darkened position. A live object should be placed in a convenient spot to give an idea of height, &c. This applies, of course, in all cases. Do not be ambitious to produce everything with a quarter plate; and do not be disappointed if you fail. For instance, focus the full moon with a plain wet plate, develope with iron after twenty minutes' exposure, and the result will be something of this kind, for the simple reason that the moon when sharply focussed will not be much larger in appearance than a pin's head, and what you observe is the tracing of the moon's progress. By way of experiment, you may try your hand at objects reflected in a looking-glass; or, try this—



Let A represent the ground glass in the camera. B the background, which to succeed should be black. Mark on A the boundary lines 1 and 2, also the centre 3 and 4. The lines drawn on the ground representing the division of the background into halves. Then place the object on the one half side of the ground; take it; pass the object to the other side; refocus and take again on the same plate. In this way may be secured two positions of the same person; or, the same features side by side, the attitude being different.



For copying a negative you may make a simple box of half inch deal, internal measurement, say nine inches every way, and blacken the inside. In the back-board an open sill work to receive the plate exactly. A is a zinc tube about four inches long, having at the end B, a common large magnifier. C supports the tube A, which may be drawn in or out to get the focus. Both camera and black box are then levelled on a piece of plank, the negative fitted in from the outside, the camera lens drawn up to the zinc tube, and the plank raised sufficiently at an angle to secure the strong but not direct rays of sun light.

Do not prepare your negative for copying or printing from, by painting out the skies. The success of a picture depends much upon the beauty of the clouds and the shadow thrown on the earth in passing. To abstract the one or the other not only distorts nature and destroys harmony, but shows also that you are not sufficiently well up in "negatives."

CONCLUDING REMARKS.

Learn to understand the reason for every step you take. The changes that may take place in the bath, either from the alteration of the solution itself (the presence of an oxide or carbonate of silver); or, as the result of any ingredient used in the preparation of the plate; an excess of iodide, ether, or acid. Note in what way the temperature of the atmosphere may affect your operations, the nature and consistency of collodion, and why one description answers better than another, and beware of ignorantly tampering with your chemicals; there is no excuse for this, *e. g.*, precipitate of oxide of silver digested with ammonia is most dangerously explosive.

By the end of your first season you will be better able to judge of your future requirements. You will, perhaps, wish you had a camera suitable for taking stereoscopic views and pictures of a larger size; lenses with waterhouse diaphrams; the arrangement of the camera back also, after the most approved fashion, either for dry plate or other work. No doubt you will have discovered that a bellows camera is more portable than one of solid mahogany. PLODDER.

ON A VARIATION IN THE METHOD OF TAKING THE SPECIFIC GRAVITIES OF LIQUIDS.

BY JOHN A. R. NEWLANDS, F.C.S.

The process consists in introducing any portion without caring to know how much, of the liquid into a small stoppered bottle, taking care, however, not to fill it.

The bottle is now weighed, and after a known volume of liquid has been withdrawn from it by means of a pipette, it is re-weighed; the loss gives the weight of the pipette full of liquid. A similar experiment having been previously performed with distilled water, we have only to divide the weight of the liquid by that of the water in order to obtain its specific gravity.

The pipette required may be constructed with the greatest ease, and in a few minutes, of a small piece of thin glass tubing, by drawing it out in the gas flame.

The lower end of the pipette should be drawn to a fine tube, and the upper portion made as narrow as possible in order to see when the mark is reached with greater accuracy.

The mark upon the stem of the pipette may be conveniently made by melting upon it a small piece of fine glass—of coloured glass by preference, so as to be more readily visible.

In using the pipette one must be careful not to draw the liquid to any great extent above the mark in the stem, as on afterwards letting it down a small portion would adhere to the inside of the tube, and the amount of substance so adhering would differ with various liquids. The same remark, though in a less degree, on account of the smallness of its surface, applies to the lower extremity of the pipette, which should dip into the liquid as little as possible.

When working with a pipette holding about fifty grains, the specific gravities found agreed pretty closely with those obtained by the ordinary process when using a 1000-grain specific gravity bottle.

When very minute quantities of liquid have to be operated upon, a piece of tubing drawn out at one end into a capillary tube may be used as a pipette, a mark being made upon it to show the height to which the liquid should be drawn up.

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THE OCCULT SCIENCES AND ANIMAL MAGNETISM.—I.

By M. Bauche.

In introducing to our readers the subject of the occult sciences and animal magnetism, we are well aware that we are not calling their attention to what is called a practical subject, but as we are equally well aware that the whole body of society is more or less pervaded with undefined notions as to the real character and pretensions of animal magnetism, we will give, at full length, a paper read by M. Bauche, at the meeting of the Société de Magnetisme, de Paris, on the 9th November, 1865, and let the learned, and, as we think, sincere professor, explain, in his own words, the difference between the occult sciences and animal magnetism, and point out the present position and the prospects of the latter science. This is the first and probably the last time that we shall give this subject room in our columns, but here is a clear and defined statement of what animal magnetism really is, and what it is not, and we think a perusal of it may tend to prevent a great deal of waste of time in useless speculation :—

The paper which I propose to submit to you has for its object the occult sciences, and mesmerism or animal magnetism, or rather my end is to combat that lamentable confusion between what we call animal magnetism and what it has been agreed to call the occult sciences, a confusion which is met with almost everywhere, in the public, in the press, in the learned world, and even in the sanctuary of justice.

This exordium is doubtless but little reassuring to that part of the audience who believe that in coming to this room they shall be present at a sitting that will prove to be more amusing than instructive, but I would fain believe that the majority think more seriously, and it is to this majority that I take the liberty of addressing myself at this moment; being wearying to no one!

This settled, I enter upon the subject: What is an occult science?

Without being a purist, it seems to me in the very first place, that the qualification occult should not be attached to the word science.

Occult, or concealed, or impossible to be seen and known, are synonymes as far as French words can be so.

Now, science means knowledge of things, knowledge clear and certain, based, upon self-evident truth, or upon experiments which demonstrate its reality.

This knowledge is acquired by study, by observation, by practice, but it can only be obtained, properly understood, with respect to things which pass not human intelligence.

A science cannot then be occult without ceasing to be a science, except to those who neither can nor will confront its difficulties.

But since the poverty of our language obliges us to couple these two words, let us first see what is understood by occult sciences.

This denomination is applied to magic and its derivatives: the cabala, astrology, sorcery, necromancy, &c., and by many to magnetism and everything connected with it.

To refute this assimilation, it will, I hope, suffice to succinctly expose the nature of these diverse things.

The word magic in its primary acceptation signifies wisdom, not in the sense that we generally attach to this word, but in that of knowledge of natural forces, of things extraordinary to that degree that they seem to be miracles.

The first magic to whom it owes its name, were the priests of the Zoroastrian religion, forming a sacerdotal corporation devoted, like all those of antiquity, to learned studies, to the instruction of peoples and kings, and to the administration of justice.

They gave themselves principally to astronomy, or rather to astrology, which secured them a high influence at the courts of the Persian and Babylonian monarchs; they also cultivated philosophy and medicine, and dominated over the populations with all the prestige of their sacred character and the benefits which they certainly spread among them.

Their pretensions to read the future by the explanation of dreams, doubtless, thus gave birth to those ideas of supernatural power which was attributed to them, and to that acceptation of marvellous science under which the name of magic has even come down to us.

But like as alchymy, whose adepts looked to nothing less than making gold, has created chemistry, that exact science to which the world is indebted for the most precious discoveries, even so likewise magic, whose starting point was the study of the secrets and the great phenomena of nature, successively brought forth astronomy, mechanics, physics, and cast the first seeds of the art of navigation, of manufactures, in a word, of all that contributes to the riches and happiness of peoples. It is to magic such as I have just presented it to you that we must go back to find the cradle of the sciences and of the arts.

So here is a science called occult (and it really was so to the common herd of mortals, since but a small number only were admitted to learn its elements), which has disappeared to give place to a series of true sciences, in the profit of which every individual is called to take his part.

Magic, as an occult science, exists, then, no longer; the magi have slept for ages in their tombs, and the wonders of our modern magicians need not disturb their ashes.

I will only say one word about what is called white magic, and which is only a science, or rather an occult art to those who know not its secrets. Happy ignorance, for it is the source of the pleasure experienced at the performances of our skilful jugglers.

The cabala, a variety of magic, is divided into several branches, one of which (that which we have to examine, taught the chimerical art of making the superior powers act in certain occurrences on the inferior world, and thereby produce supernatural effects or miracles. By pronouncing certain words called cabalistic, or by writing them on amulets, it was pretended that these powers could be rendered subject, and that by that means diseases could be cured and conflagrations extinguished.*

Sorcery is a degenerate daughter of magic, and sister to necromancy, or the evoking of the spirits of the dead.

"Its object was, among other things, to procure for man communications with spirits; but it was a matter rather of demons or even spirits foreign to the Christian hierarchy than of the souls of the dead.

"Magical ceremonies had a sombre and terrible character. It was only after a long and laborious initiation, and by going through numerous formalities, that the neophyte was admitted to communicate with the superior beings. This favour was the privilege of a small number of adepts, who took the greatest precautions to conceal the knowledge of their mysteries from the vulgar.

"The progress of civilization and philosophy brought on the decay of this sort of magic—as soon as the sorcerers ceased to be applied to, sorcery was almost forgotten."†

We are obliged to say almost forgotten, for in certain countries where instruction is but little spread abroad, the belief in shepherds, casters of lots, or sorcerers, still exists; the *Gazette des Tribunaux* often gives us a proof of it.

To come to an end with sorcery, let us say that the sorceresses (for it appears that in ancient times they were women who carried on these criminal practices) passed for having made a compact with the devil, who, in exchange for their souls, gifted them with extra-natural knowledge. "Every one knows that King Saul, afflicted and discouraged by the general defection of his subjects, and by the inward feeling of his own unworthiness, of his ingratitude and disobedience, resolved to go and find the pythoness, or witch of Endor, who called up the shade of Samuel, who predicted his defeat and death.‡

* S. Munk, Dict. de la Conversation.
† A. S. Morin, des Sciences Occultes.
‡ Walter Scott, on Demonology and Sorcery.

GLEANINGS FROM SCIENTIFIC WORKS.

Experiments on the stretching of solids showed, in the case of the metals, a decrease of temperature when the stretching weight was applied, and a heating effect when the weight was removed. An iron wire of ·25 of an inch in diameter was cooled, ·125 of a degree Centigrade when stretched by a weight of 775lb. In the case of indiarubber it was suggested that this substance stretched by a weight is shortened by increase of temperature. On trial it was found that indiarubber when stretched by a weight capable of doubling its length, has that length diminished by one-tenth when its temperature is raised 50 deg. Cent

At a height of 500 miles above the earth a cubic inch of air would expand so as to occupy a sphere equal in diameter to the orbit of Saturn.

One hundred pounds of Elgin and Wallsend coals consist of—carbon, 76·09; hydrogen, 5·22; nitrogen, 1·41; sulphur, 1·53; oxygen, 5·05; ash, 10·70; and require for combustion 241·14lb. of oxygen, equivalent to that contained in 14,243·9 cubic feet of atmospheric air.

M. de Mortillet has published in the *Sud-Est*, a Grenoble paper, a curious remedy for the sting of a dangerous insect. It is the application of the wax of the ear to he injured part.

The temperature of the air at midnight in Upper India during the months of May and June, is often over 100 degs.

Pittsburgh coal, when entirely deprived of moisture, consists of 80 per cent. of volatile combustible matter and 70 per cent. of coke.

In India bricks are burned with wood fuel, except in a few places where coal is found. No coal worth working has yet been discovered in Northern India.

Vierordt found that, with six respirations in the minute he entire quantity of carbonic acid exhaled amounted to 11 cubic inches; with twelve respirations to 25·3 cubic inches; and with forty-eight respirations, to 44·5 cubic inches.

It has been found by Becquerel that the electromotive energy of a galvanic couple with two liquids is increased by elevation of temperature. A change from 0 deg. to 100 deg., C., caused the effect to be augmented to the extent of 0·04 of its value.

It has lately been discovered that the whole of the sulphur present in ordinary illuminating gas may be removed by bringing the gas thoroughly into contact with some of the ammoniacal liquor, which is an almost valueless product of the gas-works itself.

The hydrate of magnesia formed by calcining the chloride or nitrate at a red heat, sets very soon on the addition of water, without losing its good qualities. It may thus be cast in moulds like ordinary plaster. It may be mixed with pounded marble for the purpose of giving it a grain or colour.

The value of any magnesian compound, as a source o artificial marble or hydraulic cement, depends on the proportion of magnesia contained in it. Rocks having 61 per cent. of carbonate of magnesia answer well for cement, those having 55 per cent. for hydraulic lime, while those having 16 per cent. will still be useful for stucco.

Mr. Glaisher observed that for three weeks previous to the outbreak of cholera in London, in June, 1854, the temperature of the water of the Thames had greatly increased, and that when it had attained to 60 deg. the cholera burst forth, and that when the temperature of the river fell below 60 deg. the disorder declined and ceased altogether.

Considerable difficulty is encountered in procuring suitable timber in South Australia for durable telegraph poles, and it is recommended that the lines which require repairs should be repoled with Swan River mahogany, as the local timber will not last, on an average, more than six or seven years in the ground. Contracts have been accepted for this purpose, at 17s. 10d. per pole 23ft. long.

It has been ascertained, as a test for the adulteration of cane sugar, by an admixture of grape sugar, that bichloride of carbon, added to cane sugar, and kept for some time at the boiling point of water, produces in it brown spots, which, by enlarging, ultimately cause the sugar to be of a more or less intense black: while under the same circumstances no change is produced in the grape sugar.

If white of egg is decomposed with a small quantity of sulphuric acid, dilute hydrocyanic acid, or an organic acid, and a liquor containing dextrine is poured into the turbid fluid thus produced, a precipitate will continue to be formed, even after enough dextrine solution has been added to throw down all the albumen. If a solution of gum arabic is used instead of dextrine, no precipitate will be formed, and the already precipitated albumen will be re-dissolved.

The total weight of the oxygen of the atmosphere, has been stated to be equal to 134,000 cubes of copper, one kilometre in the side. Supposing the earth to be peopled by 1,000,000,000 men, and its animals to be equivalent to 3,000,000,000 more men, and plants to have ceased from their functions, it may be shown that the yearly consumption of oxygen would be less than 16 of these cubes; or that the oxygen would not be diminished to a greater extent than one eight-thousandth part of its entire weight in a century. No sensible effect would be produced on Volta's eudiometer in a less period than 10,000 years.

In order to test the purity of otto of roses, all that is necessary is to mix five drops of the otto with twenty of pure concentrated sulphuric acid. Whether the oil be adulterated or not, a thick yellowish-brown mixture is the result. When the mixture is cold it is shaken up with three drachms of absolute alcohol. If the otto is pure the solution is clear, and remains so when boiled, but when it is adulterated the solution remains turbid.

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ART NOTES.

THE statue of Leda and the Swan recently purchased by Mr. Millais at Florence is now in the Kensington Museum. It is attributed to Michael Angelo, and said to have once belonged to Baccio Bandinelli, but we should be glad to hear more of its pedigree. It is an extremely graceful composition. The figure stands on the left leg; the right is raised, and rests on a large shell; the body bends over towards the right, and the head is thrown back in somewhat the same position as in the celebrated Slave, but it is more twisted round, and is looking down; the left arm is raised over the head, and supports the hair and the drapery, which falls in massive folds behind; the right arm rests on the neck of the swan; the face is voluptuous and pretty, but feeble, and displays none of the power of Michael Angelo; the eyes, in particular, are too liny and cutting; the arms are petty in style, and are too small at the wrists, elbows, and where they join the shoulders; the right leg and thigh are too small for the left, and the knees are feebly drawn. But notwithstanding these defects, and a general smallness of style which reminds one of Bambaia, or even of Bernini, we are inclined to think that this group is from the hand of the great Florentine. The manner of the work is peculiarly his. We are not aware of any other sculptor who, as it were, felt for the figure in the marble as he did; and the defects and corrections in the marble are some proof of the absence of a finished model in clay, without which no one but Michael Angelo himself would have ventured to have worked. The foot on which the figure stands, the hands, and more especially the feet of the Swan, are quite in his manner. The forms of the unfinished masses of marble show the hand and conception of a great master of composition, while none but a man of impetuous genius or fastidious taste would have left unfinished so beautiful a beginning.—*Athenæum.*

MESSRS. Morris, Marshall and Faulkener, artists' decorators, Queen-square, Bloomsbury, have recently filled the fourth of the gable windows of the old West Kirk, at Greenock, with stained glass, having for its subject. "The Adoration of the Lamb." Owing to the judicious use of silvery-hued and transparent white glass, this work, although particularly rich and harmonious in colour, admits ample light to the interior. The style most accordant with the work in question is that of the early fifteenth century. The composition comprises twenty-three figures of Old and New Testament Saints.

FLORENTINE papers announce that the President of the Italian Committee for the Dublin Exhibition has been informed of the aggregate prices, more than 46,000 francs, paid for sculptures sent from this country (those from Rome, we conclude, not being considered in the returns), also of the names of all artists whose works were most in request—Magni, Argenti, Galli, Corbellini, Albertoni, Strozza—such the published list.

A CONFERENCE, invited by the Society of Arts, was held on the 2nd inst., with reference to an endeavour to procure an amendment of the laws relating to copyright in works of fine art, and especially in engravings. The Council will doubtless feel sufficiently assured to persevere in the preparation of a Bill for consideration.

GLASGOW INSTITUTE OF THE FINE ARTS.—The fifth annual exhibition of works of living artists, under the auspices of the local Fine Art Institute, was opened in the Corporation Galleries, Glasgow, last week. The present exhibition is said to surpass anything that the Institute has hitherto presented. The pictures hung number nearly 900.

IN Guildhall, London, hangs an enormous picture, painted by Sir R. Kerr Porter, in 1800, representing the Battle of Cressy: one might rather say the ruins of a picture. The work being nearly twenty feet high, by thirty feet long, has been taken off the stretching frame, and rolled up. we are afraid that rats have made free with the edges of the canvas.

SCIENTIFIC NOTES.

DECOMPOSITION OF AIR BY THE TISSUES.—An essay on this subject was presented to the French Academy at one of its late sittings. The author, M. Demarquay, has examined the atmospheric air in all parts the organism in the open and closed cavities, and in the normal and diseased conditions of the system. He draws from this investigation the general conclusion that air rapidly undergoes decomposition when it contact with the tissues, oxygen is absorbed and disappears, nitrogen is left unacted on, and carbonic acid is evolved. The influence of each of these constituents of the atmosphere has been carefully examined.

STRUCTURE OF THE RETINA IN REPTILES.—Mr. J. W. Hulke, who has written an able essay in the "Ophthalmic Hospital Reports" on this subject, gives the following as the arrangement of the parts in the retina of frogs, snakes, and turtles:—1. The layer of rods and cones (bacillary layer; Jacob's layer). 2. A layer of outer granules. 3. Intergranule layer. 4. Layers of inner granules. 5. Granular layer proper. 6. Ganglionic layer. 7. Optic-nerve layer.

THE ACCOMMODATION-POWER OF THE EYE.—In a paper on the Anatomy of the Seal's Eye, published in the January number of the *Dublin Quarterly Journal of Science*, Mr. Henry Wilson, F.R.C.S.I., revives the old theory of the action of the external muscles in altering the axis of the eye. He contends that the recti muscles by their pressure elongate the axis of the eye, and thus, by increasing the distance between the lens and the retina, in some measure provide for accommodation. He forgets that such an alteration, in order to be effective, should take place to an enormous extent (an inch or thereabouts); and that the action of the muscles would tend to shorten rather than elongate the antero-posterior diameter of the eye. His paper is full of interesting anatomical details, but it is to be regretted that he has not very carefully described the relations of the ciliary muscle.

TELEGRAPHIC NOTES.

THE Russian journal, the *Messenger*, announces that Mr. Collins, one of the directors of the Russian American telegraph line, has given, in a public meeting, some further details of that gigantic undertaking. The line will encircle the globe if a submarine telegraph can be made between London or Paris and New York; otherwise the communication between Paris and New York must be made by the Russian-American telegraph, which will run across Behring's Strait. There are hopes that this line may be terminated in 1867.

FROM the official report of Mr. E. C. Cracknell, the superintendent of telegraphs in South Wales, to the Colonial Parliament, it appears that the length of telegraph lines at present in work throughout the Australian colony of South Wales is 2,520 miles, with 3,047 miles of wire, which, on the completion of the lines in progress, will be increased to 2,990 miles of line and 3,517 miles of wire. The total cost of the lines in operation on the 31st December, 1864, not including expenditure by the colonial architect, was £132,025. The net profit for the year was 6 per cent. The lines in this colony during the summer months appear to be much more affected by lightning than those in the neighbouring colonies; and it frequently occurs that not only the lightning conductors, but the relay coils, are fused by the intensity of the atmospheric charges. To guard against this wholesome destruction, Mr. Cracknell has arranged a simple cutting-out switch, which completely disconnects the conductors and instruments from the line, leaving only the main battery in circuit. This plan, he says, has been found to work very satisfactorily, and has saved the destruction of many instruments, and the consequent delay of business at the several stations so visited.

PHOTOGRAPHIC NOTES.

WET PROCESS WITHOUT NITRATE BATH.—Mr. Nelson K. Cherrill has worked during the year with some success in securing negatives without nitrate bath. To two ounces of bromo-iodized negative collodion were added 20 grains of nitrate of silver in about half a drachm of alcohol, left for about half an hour to settle, and then tried, giving the same exposure as if for the ordinary wet process with the same collodion for developement; the plates were shot into a dish containing an old iron developer made with the ammonia-sulphate, with a full dose of acetic acid. The image came out but slowly, having very much the appearance of a tannin negative under the influence of an alkaline developer. The plate was removed in about ten minutes, washed, fixed, and then redeveloped with iodine and pyro in the old style. Some further experiments were tried, the results of which were the best we have seen produced in this direction. The process is not, however, sufficiently successful yet to supersede the ordinary method.

METHOD OF PHOTOGRAPHIC PRINTING ON IVORY AND WOOD.—This consists in coating the wood or ivory with collodion, saturated with nitrate of uranium, and containing four grains of nitrate of silver to each ounce. For ivory the treatment in toning and fixing is the same as for paper, described in our last *Year Book*, in the article on the Wothlytype process. On wood the image need only be fixed and washed. The collodion should be powdery, and may or may not be afterwards removed with ether. If removed the image will be found underneath.—*Year Book of Photography.*

CHEMICAL NOTES.

ON ANILINE ORANGE.—Mr. Jacobson gives the following method of obtaining an orange-coloured dye from aniline. Red aniline is made in the usual way by the action of nitrate of mercury on aniline. The residue is then purified by boiling the resinous deposit and crystallising the solution. The mother liquor of the crystals contains small quantities of dyes of different colours, and a large proportion of orange dye. The orange is isolated by means of common salt, which precipitates the other colours and leaves the orange in solution. The dye is afterwards extracted with alcohol. The colour is a golden orange, which readily dyes silk and wool, and Mr. Jacobson speaks of using it as a sort of varnish for optical instruments and on tin foil.—*Cosmos.*

A NEW MEDICINE.—In the *Bulletin General de Therapeutique* (January 15th), M. Stanislas Martin describes a new medicinal substance under the title of *jurubeba*. Jurubeba is the term applied in Brazil to a plant called by botanists *Solanum paniculatum*. In South America the plant is used in the form of emplastrum, syrup, wine, tincture, and aqueous and alcoholic extract. It is chiefly employed in affections of the lever and spleen, in vesical catarrh, anæmia, chlorosis, and difficult menstruation. According to the testimony of several observers, this new drug promises to be the most powerful deobstruant yet met with. The jurubeba is sold commercially in the state of leaves, fruit, and roots. The latter vary in length from ten to fifty centimetres. They are covered with minute rootlets; their texture is hard and fibrous, the fibres being serrated. The stems of the plant are long and slender, and are studded with sharp-pointed prickles. The leaves attached to them have a fine green colour; they are without odour, and are nearly tasteless.

CO-OPERATION.—At the annual meeting of the Manchester and Salford Equitable Co-operative Society, it was stated that the members commenced operations with £100, six years and a-half ago, and had now a capital of nearly £14,000. They started with one shop and fifty members; they have now twelve shops and more than 2,000 members. The business of the past year had exceeded that of 1864 by £5,000.

SUBMARINE TELEGRAPHY.*

II.

SHALLOW AND DEEP SEA CABLES.

The lecturer first alluded to the omission fro the first lecture of any mention of the new insulators—balata, Parkesine, collodion, Mr. Mackintosh's material, and others. This omission was an oversight, due possibly to the fact that, as he has been unable to procure a specimen of any one of these materials for examination, he had formed no opinion as to their merits. The value of a new, good, and cheap insulator would be very great. The following is an abstract of the second lecture, under the heads in the syllabus:—

1. *Serving and Worming.*—Strands of hemp or jute are commonly laid or spun round the insulated core to serve as a pad or protection against pressure from the iron wires afterwards applied, and also, in some cases, to form a larger heart, allowing larger and more wires to be applied than could lie round the small insulated wire. This covering of hemp or jute is called the "serving" of the cable. When several insulated wires, to transmit distinct simultaneous messages, are included in one cable, as for short distances is frequently the case, these insulated wires are laid in a long strand, with hemp between them, to form a circular core. This hemp is called the "worming." The worming and serving were formerly tarred for their preservation against decay in water, but Mr. Willoughby Smith showed that the tar temporarily mended small faults of insulation, and might, therefore, conceal an accidental injury to the core; but tar was not so good an insulator as permanently to mend the fault, so that the tar might lead to the submersion of a fault which would otherwise have been discovered and repaired before submersion. To avoid this risk tanned hemp is now used, and is often applied wet, to increase the chance of at once detecting any accidental injury to the gutta-percha. Hemp under wires is remarkably durable, and jute also answers well as a cheaper substitute. When hemp is exposed in water it soon decays, and jute decays still more rapidly; both are liable to be eaten by animals where exposed, but not where covered by iron. A specimen was shown where a small quantity of hemp exposed by a kink, at a depth of 800 fathoms in the Mediterranean, had been attacked by a species of teredo; the part immediately adjacent, covered by iron wire, was intact. These animals exist in the Mediterranean even in depths of 1,200 and 1,600 fathoms. In applying the covering care must be taken that the insulated wire be not overstrained; the simplicity of the work has sometimes led to the use of imperfect machines which might cut the gutta-percha, and to the employment of boys too young to be careful.

2. *Iron Sheathing.*—The served core is commonly protected by iron wires laid round and round in a long helix, and abutting one against another, so as to present the appearance of a simple iron wire rope. This sheathing is frequently called a spiral covering, but the wires lie in a helix, not a spiral, which is a curve like that formed by a watch-spring, not that formed by a corkscrew. There is a popular impression that this form of cable must necessarily be very easily extended or stretched; but this impression is wholly erroneous. The single helix stretches by becoming more nearly a straight line, and by gradually closing so as to include a smaller and smaller cylindrical space: if this closing be prevented—for instance—if the wire be wrapped round a solid core, the helix will not stretch more than a solid wire; the closing is prevented in the ordinary cables by the arrangement of the outer wires, which abut, each upon its neighbour, so that a cross section of the cable shows a compact iron ring. The tube formed by the wires cannot diminish in diameter, and consequently the helix cannot stretch more than a solid wire; this is proved by the experiments of Messrs. Gisborne, Forde, and Siemens in the "Report of the Joint Committee on Submarine Cables," 1861. Some

* Lecture II.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, February 5

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TABLE IV.—STRENGTH AND ELONGATION OF CABLES AND MATERIALS.

PART I.—CABLES.

(The Specifications are given at the end of the Abstract of this Lecture.)

Cables.	Breaking strain in cwts.	Corresponding length in water. Fathoms.	Per cent. of elongation, with one-half breaking weight, per cent.	Per cent. of elongation, with breaking weight, per cent.	Weight per knot in air, cwts.	Weight per knot in water, cwts.	Remarks and Authorities.
1st Atlantic	80	4,979	0·24	0·8	21·70	16 30	Report of Joint Committee, App. 10.
Red Sea	65 to 87·5	3,906 to 5,112	0·16 to 0·34	0·56 to 1·16	21	17·30	Do. do. do.
Malta, Alexandria...	147 ,, 157	4,565 ,, 4,874	0·2 ,, 0·36	0·5 ,, 0·86	42·70	82 73	Do. do. do.
2nd Atlantic	154	11,000	—	2·57 ,, 4·65	35·75	14·0	Unpublished experiments by Mr. Fairbairn.
Steel and Hemp coated Gibraltar	102·5 ,, 147·5	7,928 ,, 11,407	0·62 ,, 1·24	1·87 ,, 4·03	25·47	13.11	Report of Joint Committee, App. 10.
Iron and Hemp coated	67·5 ,, 75	5,346 ,, 6,000	0·26 ,, 0·77	1·80 ,, 3·10	24·57	12 65	Do. do. do.
Siemens' Copper-covered Cable...	50	6,250	—	0·8	18·61	7·97	Mr. C. W. Siemens' unpublished information.
Allan's Cable	18·37	7,500	—	1·0	8·0	2·5	Mr. Allan's unpublished information.
Ratan and Stretched Hemp ...	15·75	8,500	0·52	1·76	7·73	5 86	Messrs. Forde and Jenkin's unpublished information.

PART II.—MATERIALS.

Materials.	Breaking strain in cwts.	Corresponding length in water. Fathoms.	Per cent. of elongation, with one-half breaking weight, per cent.	Per cent. of elongation, with breaking weight, per cent.	Weight per knot in air, cwt.	Weight per knot in water, cwt.	Remarks.
Copper strand, Malta-Alex. ...	5·75	—	0·22	8·5	3·57	3·125	Report of Joint Committee, App. 10.
Core, Malta-Alex....	5 75 to 7·5	2,260 to 2,826	0·23	22 to 25	7·15	3·36	Do. do. do.
*Iron Wire, 0·079 in.	4·18 ,, 4·5	5,600 ,, 6,040	0·12 to 0·18	0·46 ,, 0·72	96 lbs.	83·5	Do. do. do.
*Steel Wire, 0·079 in.	8·00 ,, 8·50	10,600 ,, 11,200	0·23 ,, 0·34	1·00 ,, 1·80	97 lbs.	84·7	Do. do. do.
Hemp and Iron	5·00 ,, 7·43	—	0·16 ,, 0·32	1·04 ,, 2·46	141 lbs.	—	Do. do. do.
Steel and Hemp	10·37 ,, 11·75	—	0·37 ,, 0·51	2·28 ,, 2·70	142 lbs.	—	Do. do. do.
Hemp alone...	2·87	—	—	—	45 lbs.	—	Do. do. do.

extracts from their results are given in Table IV. The stretch of the Atlantic, Red Sea and Malta-Alexandria cables before breaking is, as will be seen, hardly more than the stretch of a single iron wire (part II., Table IV.); the slight excess is owing to a slight diminution in the diameter of the cable due to the more perfect closing of the wires one upon another when the strain is applied. Owing to the perfect iron ring formed by the wires, the inner core is not sensibly compressed. A helix may elongate by untwisting as well as by closing in the manner described, and sometimes this defect has been alleged as the only serious one. The total elongation which could arise from this cause is the difference of length between the wire as it lies round the cable and when stretched out straight. This is about 1½ per cent. in the Malta-Alexandria cable; but no sensible untwisting ever does occur; about forty or fifty turns are, at most, taken out per mile, and this would elongate such a cable 18 inches per mile, or about 0·03 per cent. When cables are recovered from great depths no sensible change in the lay is found to have taken place. It cannot be seen that they have in any way been untwisted or stretched. Specimens of cable thus recovered were exhibited, and the following experiments shown to enforce the reasoning:—First, half a ton was hung on a light iron cable of the usual form, and it was seen that no stretch occurred, although less than half the weight would have stretched the core inside 20 per cent., and finally have broken it. This proved that the strain was really borne by the rigid helical iron wires outside, not by the core inside. Secondly, weights were hung on a single wire, outside a core of hemp and gutta percha; this stretched a very little. Lastly, an experiment was tried which to all appearance resembled the first, but on the weights being taken off, the rope was bent and opened, and shown to consist of a mere hollow shell of iron wires, without any core whatever inside for eighteen inches of its length. This proved that the iron wires do not press injuriously on the core. In all these experiments the rope was free to untwist, but did not do so sensibly. The experiments were simple illustrations of facts well known to all practically acquainted with telegraphic cables. It may therefore be assumed that the common form of cable is not liable to stretch, but another defect, the liability to kink, has been urged against it. A kink is a loop drawn tight, or a twist in a rope concentrated at one point. Specimens of kinks were shown. A kink may be produced in any form of cable, with or without helical covering, inasmuch as a loop or twist may be produced in any form by mismanagement. A rope coiled round a drum with one side out may be wound off and rolled round another drum, or paid out into the sea, without receiving any twist, but if, by mismanagement, the rope were pulled off the end of the drum, it would be twisted or kinked. Similarly, if coiled in a tank, with one side always uppermost, although apparently without twist, it would be twisted or kinked when pulled straight out of the hold. In practice these plans are not adopted; the cable is carried down into the tanks from a drum with one side always turned in one direction; let one side of a straight cable be marked black, and let it be coiled into the hold so that the black side shall always be north, then this black mark will, on the north side of the tank, be turned from the centre, at the south side to the centre, at the east and west side it will be uppermost and undermost respectively. The rope thus coiled in will have one twist in it for every turn round the tank; in a spun rope, this twist will twist the rope tighter, or untwist it according to the direction in which the rope is coiled; but in either case when the rope is drawn out of the coil it comes out as it was put in—straight and without twist. The extra turn or twist is caused by coiling and removed by uncoiling. There is one simple, universal, and sufficient rule to prevent the occurrence of a permanent twist. The cable must be taken out of the tank or off the drum, in the same manner as it is put in or on; the opposite course will always put a permanent twist into a cable, and this twist concentrated at one point, produces a kink. These points were illustrated by elementary experiments with a piece of india-rubber tubing to represent a cable. One side of the tube was painted so that a twist could readily be seen. When a cable is properly coiled in the tank, it is possible, by a severe jerk, so to mismanage the uncoiling as not to take out the twist regularly, and kinks have thus been caused by several turns being caught up at once out of the hold. This now very seldom happens. Not one kink occurred during the paying out of the Malta-Alexandria and Persian Gulf cables, or during the late Atlantic expedition, in all about 3,500 knots. Even when a kink does occur, it seldom injures the cable. A specimen was shown, cut from the Dover and Calais cable, containing six insulated wires, through which, kinked as they were, messages had for years been transmitted between England and France. The common form of cables affords a good mechanical protection against injury.

3. *Iron and Steel Wire.*—The tensile strength of a cable is the sum of the strength of the wires composing it. A cable covered with good iron should bear a strain equal to two tons per pound of iron wire per fathom. Thus a cable with 3,750 lbs. of iron per knot, or 3·75 lbs. per fathom, in the sheathing, should bear 7½ tons. This rule corresponds to a strength of about 41 tons per square inch. The larger gauges and inferior qualities of iron cannot be expected to bear so high a strain as this. Best Best is the quality most usually specified, but charcoal wire seems to be more permanent than the inferior brands. The wire should in no case be hard or brittle. Bright wire is generally used for the smaller gauges, and black wire for the larger gauges, unless the wire be galvanized. Table V. gives the relative weights per knot of the different gauges, according to Messrs. Johnson of Manchester. The weight of a wire per knot in lbs. is nearly equal to the square of the diameter in inches multiplied by 16,100, or say 16,100 d^2. The wires are joined by welding and the cables by splicing. These operations require no special description. Welds should not be allowed in two wires of a cable at the same point, or near the same point.

(To be Continued.)

* Other specimens of iron and steel would be found to stretch differently. Some iron and some steel would stretch considerably more, and very hard specimens would stretch less. The above results seem to be taken from fair samples.

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A SUBSTITUTE FOR THE POSITION MICROMETER.*

BY CHARLES GROVER.

[A STRONG interest attaches to the pursuit of science under considerable difficulties, and we therefore depart from our usual custom by saying a few words on the author of this communication. He is an artisan—a brushmaker—fortunately possessed of a two-inch telescope, and doing such good work with it as to have attracted honourable notice from Dr. Lee, of Hartwell House, Mr. Birt, and our own highly-esteemed contributor, the Rev. T. W. Webb, by whom this paper has been sent to us. The plan adopted by Mr. Grover is certainly ingenious, and may suggest to others, who, like him, cannot afford more perfect instruments, how much may be accomplished by ingenuity and perseverance. If a poor working man, subsisting and keeping a family upon slender weekly wages, can manage to make considerable progress in observational astronomy by the diligent employment of his leisure hours, what a wide field is open to those who can devote ample time and money to any favourite pursuit ?—ED.]

I have been greatly interested in observing the various double and binary stars, so ably treated of in your pages by the Rev. T. W. Webb, and have often wished (as I daresay many other amateurs have done) for some cheap and simple instrument for measuring their angular positions, that excellent instrument, the position micrometer, being, from its price, inaccessible to me.

After a good deal of thought, and the advice of one or two astronomical friends, I have devised and constructed an apparatus which on trial I found so useful that I have thought it worth while to send you a description of it, hoping it may prove acceptable to many of your astronomical readers.

The first thing to be done is to prepare a carefully-divided circle, of a size corresponding to the eye-end of your telescope. This may be of any suitable material, to suit the amateur's convenience. Mine is simply drawn on paper, and attached to the telescope with a little warm glue. If the telescope is of small diameter, the circle may be of larger size, so as to project all round; but then it becomes liable to be injured by contact with various objects.

As to dividing, large circles have the advantage of small ones, in giving more space for division, and crowded circles are difficult to read by the faint light allowed in the observing-room. Mine is but two inches in diameter—a size not large enough to allow of single degrees being shown on it well; therefore it is graduated by long lines to every 10°, and shorter lines for every 5°, and by dots to 2½° (see Fig. 1).

This all-important part of the contrivance being duly attended, the index by which it is to be read next comes in for consideration. This is of steel. Its form will be more readily comprehended from the drawing than from any written description. It is attached to the eye-tube by the brass screw and nut, which is pierced with a slit lengthwise for its reception and adjustment, the length of the index being so managed that when the instrument is adjusted to focus, its point just reaches the circle. The screw on lower side of eye-tube is merely to assist in revolving the eye-piece.

FIG. 1.

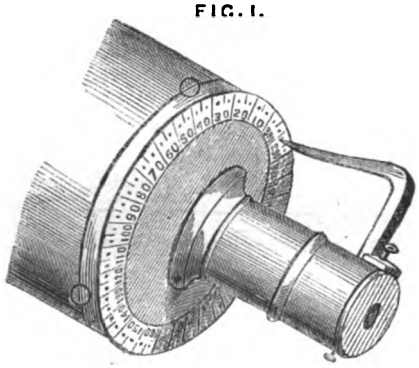


FIG. 2.

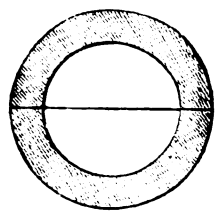


FIG. 4.

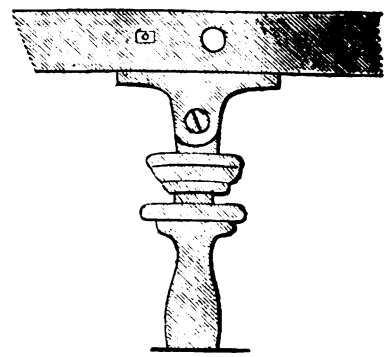


FIG. 3.

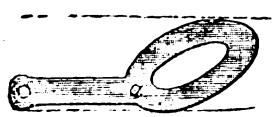


FIG. 5.

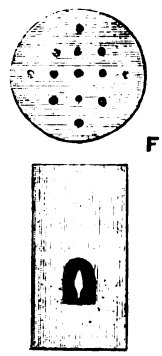
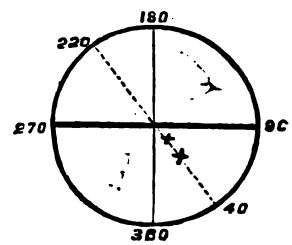


FIG. 6.



Inside the eye-piece, in the focus of the eye-lens, I have fixed a perforated cardboard disc, the opening being rather larger than the aperture of the stop always placed there, and across the field a conspicuous wire is carefully placed (see Fig. 2).

Now to render this visible during observations it needs some illuminating apparatus, and I have used with advantage an oval reflector of bright tin, with a sufficient central aperture to allow all the rays from the object-glass to reach the eye unobstructed. This is fixed inside the tube, at an angle of about 45°, as shown in Fig. 3. The relative position of the screw, and the hole for admitting light, are shown in Fig. 4. This hole needs to be no larger than a sixpence, and should be just opposite the point *a*, Fig. 3. For a lantern I use a tin canister, about 7 inches high, and two in diameter, with an opening in its side for light, and numerous perforations in the top for the escape of heat. Within this is a small paraffin lamp (see Fig. 5). The degree of light, and its distance and position with respect to the aperture in the telescope, will be better learnt by a few practical lessons than by any written instructions.

Having detailed the construction of the apparatus, we will now point out its use, and for this purpose we cannot do better than suppose a pair of stars in the field, as shown in Fig. 6. Now to measure their angle of position, revolve the eye-piece till the index is to the left side of the circle, and bringing the larger star to the edge of the wire, gradually revolve the eye-tube till the star in its motion through the field exactly traverses the wire. Note the degree indicated on the circle. This will be 270°. Now revolve the tube till the wire becomes parallel to the pair, and note the number of degrees it has turned, as from 270° to 220°. This is 50°; but as the smaller star is on the opposite side, the reading must likewise be transferred, and you must substract 50° from 90°, which leaves 40° for the angle.

As it is more than probable that there may be considerable errors of division in such a homely affair, it is best to take measures of an object in each of the four quadrants of the circle, as by so doing we, to a great extent, get rid of such error. Neither is it important that the points 0°, 90°, 180°, 270°, etc.; should correspond to their proper places in the field, as if in the first instance just named, instead of 270°, the index read 140°, we should merely write 140°, 270°, and proceed as before. The angle made by a line joining the two stars, with the line of their motion through the field, is all that is wanted.

Professional astronomers may smile at the roughness of the contrivance; but to the amateur to whom expensive appliances are inaccessible, it will be found, when used with care and discretion, to be no mean help in the prosecution of his favourite science.

* From the *Intellectual Observer*, January.

HER MAJESTY AND A ROYAL ARSENAL WORKMAN.—Some few months since a workman named Henry Knell, employed in the carriage department of the Royal Arsenal, Woolwich, composed and published a work, entitled, "Chips from the Block," being essays upon questions connected with social science. Her Majesty, having seen a copy of the work, forwarded to the author, through Sir Charles Phipps, a cheque for £10, accompanied by a letter expressive of Her Majesty's approbation of the praiseworthy manner in which the author had occupied his spare time. Mr. Knell has just brought out another work, being a "Guide to Woolwich Arsenal," and containing interesting details of the several departments of that establishment. A copy having been forwarded by the author to the Queen, Her Majesty has, through Sir Charles Phipps, acknowledged the receipt of the same, and expressed her entire satisfaction with the contents of the work.

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THE LATHE AND ITS USES.*

VI.

CHUCKING.

Chucking work in the lathe is one of the most interesting branches, for here there are no centres in the way to plague the workman, and the tool has a fair sweep at all parts. Everyone who uses a lathe should get a scroll chuck; that is, a chuck where the jaws move up together toward the centre, so that any round piece will be held perfectly true. This is a great convenience, for whether we have a ring to bore out, or a wheel to turn off, it is equally handy, and is far better than the independent jaw chuck, which has to be set up by measurement, and repeated trials before it is right. To those who cannot afford to purchase a scroll chuck a wooden one can be made to answer every purpose. Wooden chucks should be made of some hard, fine-grained wood, such as maple or mahogany, so that they will hold well whatever is driven into them.

If we have a small cylinder head to turn, for instance, the back head which has no hole in it to put a mandril through, as the front one has, the wooden chuck will come in play. To make one, the turner takes a square block of the proper thickness, say one inch, and saws the corners off so that it is eight-sided. It is then ready to screw on the face plate of the lathe. This is quickly done by having small screw holes in the plate for this purpose, as shown in the engraving at the head of this series.

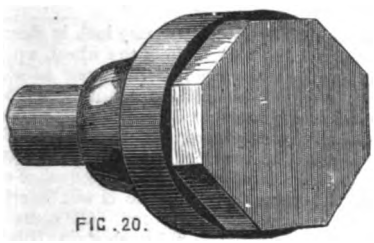


FIG. 20.

The block is then all ready to work on, and the face must be turned off true, and a recess cut out in it to receive the head. This is the head, Fig. 21.

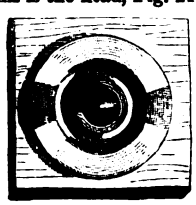


FIG. 21.

On the back side there is a projection to fit the cylinder of the engine. This must be turned first, and the flange faced off true; after that the head must be pryed out (by making a little recess in the chuck alongside of it), reversed and put in the chuck again, the finished side in, so as to polish it on the outside. It must be driven up tight against the face of the chuck, otherwise the flange will be thicker on one side than the other. In finishing, it will be found better to commence near the centre and work out toward the largest diameter, for it is necessary to get under the scale, or sand left on in casting, first, before the work can be turned true, and this is easiest done by beginning at the middle where the speed is low. The scale is fused sand melted on the metal in the act of casting. The best tool to do this with is the diamond-point, for it can be employed universally on straight or hollow surfaces, is easily ground, and always works well. After it comes the scraper previously shown. If these chatter, a piece of leather must be put between them and the rest. It is also well to put a stout iron rod or piece of hard wood between the back centre of the lathe and the face of the plate; this keeps everything steady, as shown below, so that a beautiful lustre will be given by the tool alone.

After the plate or head is firmly scraped, it must be polished with flour emery, and oil. The emery first used must be No. 1; if the work is brass, however, this will not be needed. This must be plentifully supplied with oil, so that it is like cream, and the workman, taking a soft pine stick, with the end pounded into a brush, so that it will hold emery, holds it hard up against the face of the head. If it has been properly scraped a few revolutions will produce a fine-grained finish but if it is badly done, the corners will be full of scratches and chatters. It takes time and experience to make a good finisher, and patience, also, for men who are good turners, and can make excellent fits, are sometimes botches at polishing.

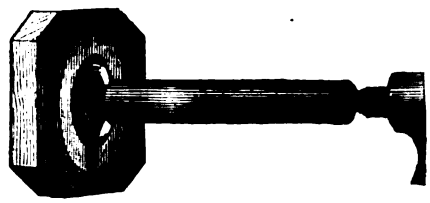


FIG. 22.

After emery of the finest possible description has been used, a little rouge powder should be put on a piece of buckskin and applied to the work. This will make a polish equal to gold on brass, and like silver on iron. Instead of these methods many persons burnish their work. The burnisher is sometimes made of steel of bloodstone and of agate. Steel is the material generally employed. It is polished as bright as can be on a buff wheel, and must be preserved so, otherwise it is useless to attempt doing anything with it. Pumice stone is very good for polishing with, or rather for finishing the surface before polishing. Other substances will be mentioned hereafter. Steel and iron are best polished with a sharp tool and water. To turn steel with a handsome surface the tool must be sharpened on an oil stone and the speed high, then spit on the work and take light cuts, and you will have a nice job. To make a very brilliant polish on steel it is necessary to use emery and oil, plenty of oil and not much emery, but this makes such a nasty mess on the lathe that few good turners will do it. A file should not be used in the lathe if possible; filing a job makes it uneven, and spoils the look of it. It is difficult to avoid scratches, and the expert can generally tell the difference between work that has been turned true and that which has been filed, and in nearly all cases it is quicker to turn the work to fit or to finish at once.

In polishing round work, such as rods or shafts, it is much cleaner and more expeditious to make a pair of clamps like this, and put the emery and oil on leather pads between them. The clamps consist of two straight pieces of soft or hard wood lined with leather, though some use sheet lead.

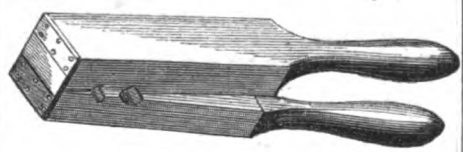


FIG. 23.

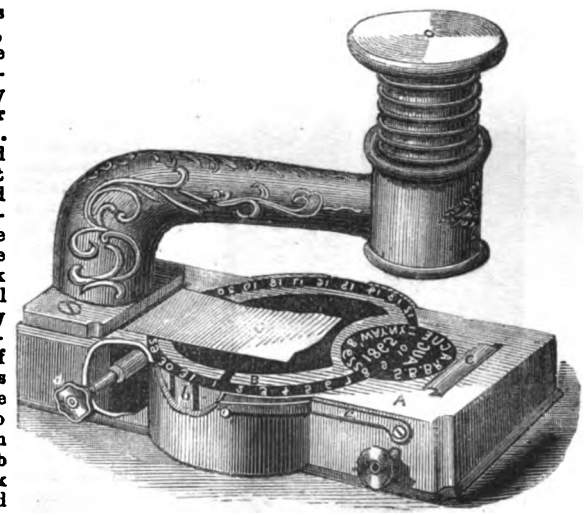
The leather catches the polishing material and holds it, and, at the same time, keeps it continually applied to the shaft. The clamps are slipped over the same, and the ends held in the hand. This utensil also gives a fine finish to the work, making it smooth and even. It must be carried regularly along from end to end, sometimes fast and sometimes slow, so as to cross the lines, or avoid making a twist in the polish like a screw thread, which would otherwise be given. A very beautiful and brilliant lustre can be given to a shaft of iron or steel, after it is nicely finished, by holding a sheet of sand paper covered with chalk, not emery, of a fine quality on it. The glaze that this gives makes the work glisten like silver, but it also takes off all the grease, so that the shaft is very sensitive to moisture, and is quickly rusted.

This discussion about polishing has led us away from the consideration of chucking, which we shall enlarge a little more upon.

* Mostly compiled from *American Journals*.

IMPROVED CANCELLING STAM .

The object of this improvement, by S. B. Brague and William S. Starr, of New York City, is to save the trouble in changing the date. In ordinary stamps the date is changed by taking out types and putting in others; and in this process the types are liable to be lost or damaged, and to be imperfectly fastened; and there is some liability to error in the date. In this stamper the date figures are soldered to a ring, which turns in a groove, and his held by a catch-pin which takes into holes, so that each date figure is secured in its proper place. The monthly and yearly changes are made in the usual way. A and B show the body of the instrument, which is cast hollow, and has in it a groove in which the ring, *b*, to which the date figures are soldered, revolves. The spring



c, screwed at one end to the body, has near its other end a pin with a head by which it may be drawn outward. The end of this spring is bent at a right angle to form a catch, which catches into notches in the ring, as shown at *b*, in the space broken open to show the ring. By raising this catch from a notch, and turning the ring slightly, which is done by the thumb nail applied in a notch on the further side, the catch is placed half-way between two notches; it is then released and allowed to press against the ring; the ring is then moved further, by the thumb nail taking hold of the next notch, and the catch springs into its proper notch, and holds the ring. Thus it is made sure that the ring will not be moved forward more than one notch or day, unless the spring be purposely drawn back; and the liability to error is thereby lessened. The inking ribbon, C C, which is broken to show the stamp, is arranged in the usual way, on two rollers which are turned by their milled heads, *a a*. The paper to be stamped is laid over the stamp, with the inking ribbon intervening, and the spring bolt is driven down by a blow of the hand, as usual in stampers of this class.

The chemical works at Pocket Nook, St. Helen's, formerly the property of Messrs. Balmain and Co., have been purchased by a limited liability company and will be again in full operation early next month. A number of artizans are busily engaged in the work of preparation.

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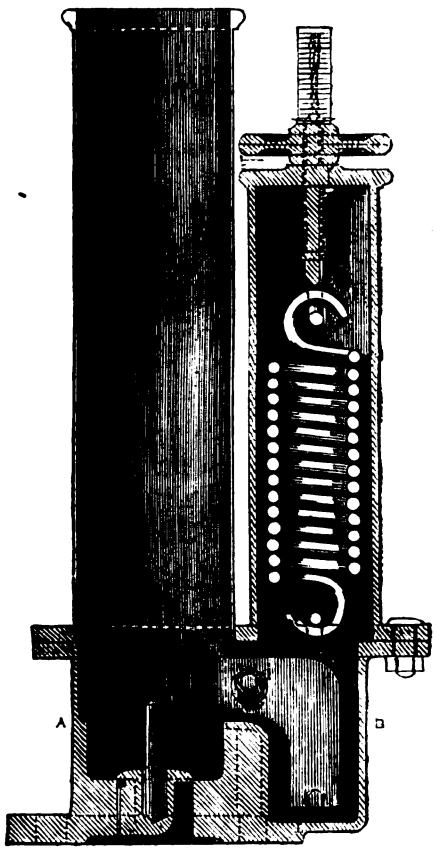
SAFETY VALVES FOR STEAM BOILERS.

THE following is extracted from a paper on the subject, read by Mr. George Campbell, before the Leeds Association of Foremen Engineers a short time since, and which has been published by order of the Association.

There are certain qualifications which a good safety valve ought to possess, and the principal of which are simplicity in construction, a free and sufficient exit for the steam; by this means we get one that will not allow the pressure in the boiler to exceed the weight on the valve. Further, a good valve should not be liable to be inoperative from sticking by friction, through pins and rubbing surfaces; and above all, if it all possible, beyond the reach of tampering with the weights by the hands of the ignorant, the malicious, or the reck-



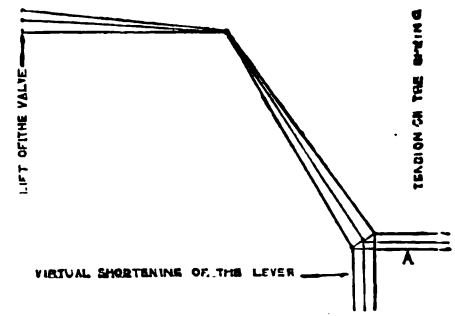
less. The valve of Mr. W. Naylor, of London, possesses in some degree, the qualifications recited, and before describing this arrangement, a section of which is shown in the illustration, we will look at it in comparison with the ordinary steelyard lever and stalk valve.

Tredgold, in his able and valuable work on the steam engine, says:—"It would be a great improvement on safety valves if they could be so constructed as to be relieved of a part of their load when raised from the seat." Safety valves, as generally loaded with a spring balance, especially n the locomotive, portable, or other boilers subject to oscillation, instead of complying with Tredgold's sound observation, have a contrary effect when rising from their seat, increasing to a serious extent the load on the valve and strain on the boiler, which, no doubt, most of you have observed when looking at the valve blowing off, compared with the pressure shewn on the pressure gauge—a difference in excess, on the valve, of 20 pounds per square inch (sometimes more) being a common occurrence, if the fire under the boiler be urged, and the steam so generated not drawn off by any other medium than the safty valves.

This can be easily shewn by calculation. Take for example:—a valve, 4 inches diameter, equal to an area of 12½ square inches, consequently the lever must be 12½ to 1, for one pound on the end of the lever, to give one pound per square inch on the valve. Taking the angle of the valve seat at 45°, it will be found that the end of the lever, where the spring balance is attached, must be raised half-an-inch to obtain an opening at the valve of ·3551 of a square inch, an opening not equal in area to a round hole 11-16ths of an inch in diameter. Then, if we take the graduated range of the spring balance at 30 pounds per inch, it will be clear that by raising the lever half-an-inch at its end (to obtain even the above small opening), an additional pressure of 15 pounds per square inch is put on the boiler by the tension on the spring balance; there is beside this extra load by the balance, friction by the joint pins in the lever and friction caused by the steam issuing through such a small opening. These, with the resistance of the atmosphere, have the effect in causing a great amount of needless pressure on the boiler, when the steam is blowing off strong at the safty valves. A theory has been advanced to account for the small rise of the valve from its seat, thus:—"That by the instantaneous reduction of steam pressure under the valve, so soon as an outward current has been established, motion takes the place of dead pressure, consequently the pressure in the boiler sometimes rises dangerously above that to which the safety valve is loaded." A valve has been designed to supply the defect pointed out by this theory, and shown in the Exhibition of 1862, by Mr. Bodmer, of London.

We will now proceed to describe Mr. Naylor's arrangement of valves, and shew how it obviates the increase of pressure by the rising of the valve, for the escape of steam.

By reference to the figure it will be seen that the valve itself is of the ordinary kind, free in its seat, as shewn, to prevent binding. The lever has one end bent downwards, and the spring for loading the valve is attached to the lower end of the lever, by a loop-link: it will be apparent that as the valve is lifted by the steam from its seat, that is, when the pressure inside the boiler exceeds the weight on the valve, the bent end of the lever moves inwards, or towards the valve, thereby virtually shortening its length, and relieving the weight on the valve, although the tension on the spring is increased by the same movement. This is the principal improvement over the ordinary form of lever, which, as we have seen, increases instead of diminishes the weight on the valve. The amount of relief given to the valve as it opens by this arrangement of lever, may be varied to any extent by the angle given to the lever and the range of tension on the spring. In the diagram of the lever, the lift of the valve, the tension on the spring, and the virtual shortening of the lever are shewn magnified six times. The thick lines shew the dead position of the lever; the dotted lines shew the movement of the lever at its half and full extent of travel. The horizontal lines to the right at A, shew the amount of tension put on the spring, by the movement of the lever from its dead position, to that of full travel; and the vertical lines at A shew the virtual shortening of the lever by the same movement. The tension on the spring is taken at 600 pounds per inch, then when the bent end of the lever is at an angle of 55° with the horizon, and with a tension of 1192, pounds on the spring, there will be a pressure of 170 pounds per square inch on the valve; but when by the excessive pressure of steam, the valve has been lifted two degrees, or ·043632 of an inch, the spring has become loaded 36 pounds in excess, of the original tension, but to counteract this excess, the bent end of the lever has become virtually shortened ·09 of an inch, reducing its effective action on the valve, whereby the pressure on the valve is reduced from 170 to 168·4 pounds per square inch; this reduction of pressure will be apparent to all of you as a great improvement, opposed to what we saw done by the long lever and spring balance, when the valve is open for the escape of steam. The lift of the valve under consideration is taken at two degrees, the patentee having found by experiment, that with his arrangement this is the average extent of lift for the escape of steam under ordinary circumstances. The lever and spring are enclosed in a box, out of reach of the person in charge of the engine or boiler, so that he is unable to everload the valve by holding down or hanging extra weight on the lever, but the person in charge of Mr. Naylor's valve can regulate the pressure by the nut wheel, on the top of the spring box, drawing out, or putting tension on the spring until the maximum pressure at which he is allowed to work has been attained, when the shoulder on the screw attached to the head of the spring comes up to the underside of the spring box, rendering it impossible to increase the pressure by that means. Of course the attendant can at any time slacken or ease the pressure down to zero. The amount of



pressure on the valve per square inch is shewn by the index plate on the side of the wheel, a pointer being fixed on the head of the screw as shewn. Again, it will be seen that friction is reduced to the least possible amount by making all the bearing points of the steelyard, or knife-edged form. A spring, as the mode of weighting, may be objected to from the fact that in consequence of the continual tension on it, in time it will deteriorate and be incorrect in its work. Of course this objection can be raised to "Salter's spring balance," as applied with the ordinary lever. Still this deterioration seems to be so slight that the spring holds its place as a mode of weighting safety valve levers. Many of the valves on the locomotive stock of the London and North Western Railway are directly loaded by such a spring as is employed in this valve of Mr. Naylor's. Granting that the deterioration of the spring amounts to anything, it is at least on the side of safety, relieving instead of increasing the pressure on the boiler.*

With regard to the carrying-off power of this valve the patentee says:—"From experiments made upon different locomotive engines, generating as much steam as they were able, when standing, with a coal fire and steam jet on in the chimney, he found that *one* of these safety valves, only two inches diameter, carried away the steam, and kept the surplus pressure down thirty pounds to the square inch less than *two* valves, each four inches diameter, loaded by long levers and spring balances, were capable of doing." On one of the largest locomotive boilers in the country, *two* safety valves each four inches diameter, have been taken off, and *one* of Mr. Naylor's, only two inches diameter, substituted. The above fact requires no comment; its speaks strongly to the pratical efficiency of the valve I have endeavoured to describe.

After the reading of this paper, a conversation ensued as to the merits and demerits of the valves described. It seemed to be the general opinion that the "Naylor" valve was a decided improvement, and one likely to be employed to a considerable extent on steam boilers. Some of the members, who had seen the valve at work, spoke to its practical efficiency, fulfilling all that it was set forth to do.

TRAMWAY IN DARLINGTON.—The Darlington tramway, upon Train's principle, has turned out a losing speculation, the shareholders having lost nearly the whole amount of their subscriptions.

* The patentee has now inserted an India-rubber diaphram at the bottom of the spring box to prevent the escaping steam from acting on the spring.

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THE FILE TRADE IN SHEFFIELD.

The file manufacturers, in view of the present aspect of the trade, have formed an association, to the funds of which five houses alone have given their names for £5,000. A committee has been formed, by whom we are requested to state that no communication has been received by the masters from the file-grinders requesting an interview since they gave a month's notice on the 13th January. It is understood that during the next fortnight the various houses will exercise their own discretion as to continuing to employ their grinders or not. The Filesmiths' Union have "put down" the opposition which was made by a small portion of their body to the amalgamation with the grinders, and they will use the whole of their resources in aid of the common cause. We hear it stated that the file-grinders can "stand out" for seventeen weeks on their own funds, but the filesmiths are not so well situated to meet a lock-out. It is asserted that the union are considering the advisableness of adopting the co-operative principle as a means of enabling them to avert the effects of the lock-out. For some time they have been manufacturing files on their own account, and they have a large stock ready for the market, and will endeavour to obtain orders direct from the factors.—*Sheffield Independent.*

CHLOROFORM FOR REMOVING STAINS OF DRY PAINT.

An accident, involving the loss of several ounces of chloroform at a time when in consequence of a sudden and unprecedented demand, it was peculiarly valuable, introduced me to the knowledge of a fact I was previously unaware of—viz., that chloroform is capable of exerting a powerful solvent action on dry, white-lead paint. The accident happened in this way. The four ounce measure I was using, had been broken, and afterwards carefully mended with white-lead, several months being allowed for it to become thoroughly hard. In that state it was, as I imagined, capable of resisting for at least a short time the action of any of the more powerful solvents to be found in a chemist's shop. On pouring chloroform into it, however, I was at once undeceived, for the bottom fell out immediately, without sufficient warning to enable me to save one drop of the liquid. Had it been mended with barley sugar, water then poured into it, the effect would not have been more sudden. To turn this loss to some account, I then tried comparatively the respective effects on old paint-work of ether, benzol, bisulphide of carbon, and chloroform. I found that the last, applied on wadding with gentle friction, speedily exposed the clean surface of the wood, whilst the ether and benzol removed the more recent only of the layers of paint. Bisulphide of carbon apparently was without action. Query, then, would it not be advisable in cases where valuable dresses have been to all appearance spoilt, by paint being allowed to dry upon them, to try the effect of chloroform before giving up all hope? At any rate I shall try it on the first case I meet with. I have already discounted the smiles of the fair ones, whose gratitude I intend to deserve. By Thomas B. Groves, F.C.S., Weymouth.—*The Chemist and Druggist.*

BRICKWORK.

Long bands of iron hooping are now extensively used inserted along brickwork to give additional strength. I would suggest six slits on the broad surface of each brick (to be formed in the mould) to receive the bent ends of short pieces of iron hooping. Bricks laid side by side, or end ways, can be firmly clutched or *ironed* together by a tap with the trowel. The iron being sunk in an indention level with the brick, with a slight layer of mortar to rectify any surface inequalities, there would be no obstacle to the level setting of the work. For vaults, arches, chimneys, &c., I believe it would prove valuable.—R. TAYLOR.

WATERPROOF PAINT.

An article in the nature of paint, yet combining more of the preservative and less of the flaky nature of the common lead and oil preparation, was long a great desideratum among mechanics and builders. Our European and coasting steamers, as well as shipping of every description, require expensive outlays at either port of entry, in repainting smokestacks, rigging, and hull. Among shipmasters and builders, tin, zinc, wood, leather, and iron manufacturers, the prime object has been to secure a paint impervious to water, and durable against sea atmospheres and the wear of ordinary use and exposure. It appears that Messrs. Spooner, of Boston, Mass., have prepared a paint known by the name of "elastic black varnish paint," which, unlike varnishes, contains no coal tar, and at the same time yields an even and rich lustre, with a body of treble the consistency of ordinary black paint. For painting iron which is to exposed to heat or the weather, such as boilers and ohimney-tops, radiators, railings, and steam-pipes, this black varnish paint is said to be peculiarly well compounded, since the warmth or atmosphere neither causes it to emit the nauseating odour of benzine, so often arising from newly heated radiators, nor scale off and corrode. It is also a baking varnish, and possesses the two fold advantage of its paint and japan nature over common varnish.

PHYSIOLOGICAL ACTION OF IRON.

A new theory of the action of iron upon the system has been started by Herr Dr. Sasse, in a paper reported in Schmidt's *Jahrbucher*. This *savant* considers that the salts of iron replace, as it were, the blood-globules by acting as carriers of ozone. It is of no importance whether the iron be administered as an oxide, a per-salt, or a proto-salt; for, when once it has entered the circulation, it continually takes up and gives off ozone till it is expelled from the body. Dr. Sasse concludes that we have in iron a means of promoting the process of oxidation; but we should never administer this medicine except in cases where the process of oxidation is not sufficiently energetic. He considers that iron should not be employed in tuberculosis.

TESTING ARMOUR PLATES.—Armour plates are now tested at Portsmouth in a different manner to that formerly followed. According to the old arrangements, the plates were bolted to the side of some old wooden ship selected for the purpose, and fired at with a 95 cwt. 8in. smooth bore gun, throwing a spherical shot with a charge of 16lb., and fired from a gunboat moored at a distance of 200 yards from the plate. Under the new conditions, the plate is but 30 ft. from the gun, the size of the letter and the weight of the shot being the same as before, but the charge being reduced to 13 lb. In order to carry out this test, a line of battle ship, formerly used as a target ship, has been cut down to her lower deck beams, and a length of 30 ft. of her lower deck amidships has been stripped of its overhead planking. At the fore end of this roofless space, a massive bulkhead has been built athwartships, and to this the plates to be tested are fixed. Thirty feet abaft this is placed another bulkhead, forming the face of the battery. This is furnished with four ports, and is plated with 4½ in. plates. The test is conducted by firing five shots at each end of the plates under trial. After the guns are trained, all hands retire below the deck, and the guns are then fired by electricity. Two 6 in. armour plates, made by Messrs. Cammell, for the new double screw frigate, Penelope, were tried in this manner on Saturday last, and stood the test satisfactorily.

THE DUPLEX LATHE.—The large lathe recently set up by Messrs. Whitworth and Co., at Messrs. Maudslay, Sons, and Field's, has a slide rest arranged for duplex tools, but we observe that only the front tool is employed in turning large shafts.

THE workmen of the Stella Coal Company's collieries have presented a beautiful timepiece as a testimonial to their late manager, Mr. Simpson.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

Sir,—Although we ought at all times to be able to "render a reason for the faith which is in us," yet, it is not always convenient to recall all the circumstances whereby we have been led to pin our faith to a certain doctrine. I have been called upon by Mr. Bacon to give my reasons for believing that C. O. is the fatal cause of loss of life generally believed to be produced by $C.O_2$., and am asked to forgive his criticism if unjust; the latter I can readily promise him, since it amuses him, and cannot harm me. The former however is a more tedious task, which I hope he will not think me unkind in not fully undertaking, as it might involve a loss of time which I can more usefully employ.

Without going back a century or so (during which I think the opinions of eminent chemists have wondrously varied from each other), I may refer him to a work entitled "Cours Elémentaire de Chime," par H. Debray, Professor at the Lycée Charlemagne, Paris, dated 1863. He says, "Oxide of carbon is not only irrespirable, but an extremely violent poison. For a long time its action was attributed to carbonic acid in cases of asphyxiation by burning charcoal; M. F. Leblanc has shown that the principal effects are due to *carbonic oxide*. Thus a dog dies by asphyxiation more rapidly in an atmosphere containing three or four per cent. of $C.O_2$, produced by combustion of charcoal, than in an atmosphere containing thirty or forty per cent. of pure $C.O_2$., the reason being that the combustion of charcoal *always* produces C. O. One, or one and a half per cent. of oxide of carbon mixed with air renders the latter deadly! Whereas thirty or forty per cent. of carbonic acid is not so! Carbonic acid is simply an anaesthetic," (and I am told has been used as such medicinally,) "but is not a poison, while oxide of carbon rapidly de-oxidizes the blood in the lungs, hence is a virulent poison." With such a statement before me, made so recently as 1863, I do not think any of the deductions I have drawn from it deserves the epithet of "uncompromising statements." If carbonic acid is simply an anaesthetic, why do people die so *instantaneously* and *persistently* when they descend a well? If only a state of coma is produced, we ought to expect the men to recover in most cases at least, but experience teaches the contrary. I know not from what source Mr. Bacon has obtained the chemical physiognomy of the two gases which he gives, but I think that we are not yet sufficiently acquainted with all natural phenomena to be enabled to say dogmatically that "C. O. is not developed in any process of nature."

The inference drawn by Mr. Bacon by what he calls "a parity of reasoning" I need not touch upon, as most of your readers who have any knowledge of chemical science will readily appreciate its value, and the validity of the principle upon which it is drawn.

I am however sorry to find Mr. Bacon descending from the pedestal he has appropriated to himself as a "Critic," to the low ground of cavilling at a typographical error. Were I inclined to retort I might inform him that oxygen is not spelled "oxogen;" but I would much rather pass by such trifles, and inquire, what are the injurious effects that he anticipates would result from the introduction of oxygen into the stomach? especially since so large a portion of this gas daily enters that receptacle, certainly in combination with other gases, a decomposition of which however takes place in that laboratory. WM. TONKES.

CUTTING SCREWS.

Sir,—I see occasionally in your valuable paper instructions for cutting screws. I have a very simple method for finding wheels for rough threads—

Ex:—To cut $\frac{5 \times 2}{8 \times 0} = \frac{10}{8} \times 5 = \frac{50}{40}$ Mandril Screws.

1⅛in. placed thus $\frac{13 \times 2}{8 \times 0} = \frac{26}{8} \times 5 = \frac{130}{40}$ or $\frac{65}{20}$

Leading screw two threads per inch. A. CRANSTON.

A CURIOSITY IN ENGINES.

Sir,—Will any of your readers kindly oblige me with the information required in the following matter? I have bought a peculiarly constructed engine (and boiler), and am anxious to become acquainted with its antecedents. The engine has two vertical cylinders, each 3in. bore and 10in. stroke; the piston rods have cross rods each with a wheel at either end working in between guide bars. The pump and governors, all of gun metal, are fixed on an iron head-plate which is placed over ironwork forming a tank for supply of boiler—the latter being placed on one end of the tank, so as to dispense with brickwork and fixing. I cannot get the boiler to generate steam sufficiently quick to supply the cylinders—or, if I start the engine with a pressure of 35 to 40lbs., in five minutes thereafter it falls to 15 or even 10lbs. Without doubt the boiler was made for the engine: but where is it faulty?

The exterior diameter of the water jacket is two feet, the interior (which forms the fire-box), measures 14in. The cylindrical boiler above the water jacket is supported by 4 cast iron pipes only; the diameter of last mentioned boiler being, if anything, rather larger than the interior of the water jacket, or firebox. The height of the cylindrical boiler, which tapers upwards, is 3ft. 6in., and inside this another small boiler, containing ten tubes of about 1in. diameter. Thus there is great heating surface for the size of the boiler—but is there enough for the engine? If not, what is the best description of upright boiler suitable for such an engine; the diameter at bottom not to exceed, if practicable, 2ft., with the probable cost; also horse power of engine? M. J. G.

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ACCIDENTS IN MINES.

Sir,

In the article on "Accidents in Mines," signed Joseph Newton, your correspondent appears to have overlooked a very important fact in connection with the diffusion of gases through porous substances, viz.:—That carburetted hydrogen will pass through a porous medium in much less time than an equal bulk of atmospheric air.

This may be proved by the following experiment which is described in "Fowne's Manual of Chemistry,":—"Take a large sized glass tube open at both ends, and fill up one end by pouring into it a mixture of plaster of paris and water so as to form a stopper about an inch thick. If this tube be now filled with hydrogen gas and inverted in a glass of water, it will be found that the water will soon rise in the tube, which is caused by the hydrogen passing out through the pores of the plaster faster than the air enters to replace it, or in other words, through the superior diffusive power of the hydrogen gas over the atmospheric air."

In the case of the balloon when taken into an atmosphere of "fire-damp," the distension is caused by the earburetted hydrogen entering faster than the air passes out.

GEO. HARDEY.

CIRCULAR KILN.

Sir,

As it was observed in the MIRROR OF SCIENCE that you would like to hear of the circular kiln by Hoffman being used nearer home than Belfast, I would call your attention that one built by that gentleman has been at work for nearly two years at Bishop's Waltham, composed of two rings, each ring composed of twelve chambers; in practice only one compartment can be opened every other day at the most. 70,000 bricks are the most turned out per week, and in the hot weather the inner ring cannot be used at all, as the men cannot remain more than two minutes in it, as the heat is so much; and that proved certainly not a profitable investment.

ARTHUR RICKETTS.

BALLOON ASCENTS.

Sir,

In your edition of Feb. 2, No. 45, I see an article on Balloon Ascents, and reference is made to the sculptures from Nineveh to prove that they had a knowledge of aerostation in those days. Now anyone who will examine those sculptured remains brought from thence, will see at once that they had no knowledge of perspective, and that many of the objects which should have formed a background of the picture are as it were suspended in mid air, as for instance, boat, trees, and the slain in battle, &c.

Have not some of these objects been mistaken for balloons? In my humble opinion they have.—J.A.J.

CARBON FOR ELECTRICAL PURPOSES.

Sir,

I sometimes think that amateur gentlemen delivering their cogitations in an oracular style on subjects that may be a kind of mania with them, scarcely exercise that reticent prudence which a more profound and practical acquaintance with their subject would most surely suggest.

In your estimable and ably-conducted serial, I have observed a number of queries, and answers thereto, regarding cheap telescopes fitted up with single lenses, paper tubes, &c., the object being to save expense; this, no doubt, is laudable, but where have your telescopic correspondents been born that they do not know that in almost every town in the kingdom there are second hand shops that will supply instruments of every quality and price, and the worst of them infinitely superior, as well as cheaper, than anything an amateur could ever hope to put together, or be of the slightest use after it was so? Why, I am in possession of a first-rate reflector, which I picked up for 6s., also a Ramsden, for which I think I paid some 4s. 6d. A friend of mine the other day showed me a beautiful little instrument, by Carey, for which he paid 3s.

I have been led to make the above remarks by the perusal of a reply to "Carbon," by Mr. Tonkes, in which that gentleman seems to wish his readers to consider the cutting of carbon blocks into plates as a delightful drawing-room experiment. His advice appears to me to be a penny wise and pound foolish one. He expends 9d on a block of so-called carbon, at least two or three shillings on a tenon saw, will, perhaps, require to stimulate his exhausted energies after the operation of cutting the said block of carbon, entailing a sum total of expense, the half of which would purchase six plates of genuine carbon, beautifully cut and ready for use. I should like to ask Mr. Tonkes what he considered was the value of his tenon saw after he cut six plates, assuming that it was carbon for electrical purposes that he cut. No doubt, "Carbon" may obtain at the nearest gasworks any quantity of refuse, for the smallest coin, or for no coin at all for that matter. A cinder snatched from the grate is carbon, so-called, and will conduct electricity in a way—so will a piece of the most bastard copper that ever was compounded. If "Carbon," or any of your correspondents will call at my premises he may have carbon by the hundred-weight gratis that may be cut with a tenon saw, or zinc saw for that matter. If the cutting of carbon was so simple a matter as Mr. Tonkes considers it to be, I certainly should have dispensed with the erection of an expensive machine to effect this, and surely the leading philosophical instrument makers of London would not pay so high as they do for genuine carbon if the matter was so easy; as well might your correspondents send to Aberdeen for a piece of red granite, and attempt to cut it into plates with a saw, as to cut a piece of carbon of the density we are in the habit of sending out daily.

PETER HENDERSON.

3, Park Hill, Clapham,
Feb. 14.

VENTILATION.

Sir,—In your remarks on Giffard's injector, No. 41., p. 178, should not "sympathy," third line from the bottom of first column, be read "suction"?

The same principle seems to be involved in the power that steam, issuing from a small aperture at a high pressure, has in creating a draught. Air possesses the same power, as may be seen from the following extract from the *Intellectual Observer* for the current month—February:—

"NEW PRINCIPLE OF VENTILATION.—An experiment recently made by M. Galibert illustrates a principle which there is reason to believe, may be effectively applied to purposes of ventilation; namely, the power possessed by compressed air of deterring the entrance into an enclosed space of a very large quantity of air from without. He used for illustration one of the bags employed with his respiratory apparatus, holding about 120 litres, and having an aperture in its upper part ten centimetres wide. Keeping the aperture open he continued for four or five seconds to project into it air compressed by the mouth and lips, after which, on closing the aperture, the bag, though perfectly empty previously, was found to be one-third full of air, and it was completely filled by repeating the operation twice, though all the air introduced from the mouth did not exceed three-quarters of a litre, that is, one hundred and sixtieth of what had entered." J. H., AMATEUR.

OUR SUBSCRIBERS' NOTES AND QUERIES.

POLISHING WORK.—Will any reader inform me of the best turning tool to polish work without filing it for ordinary work to use in a slide rest?—JOHN WEBSTER.

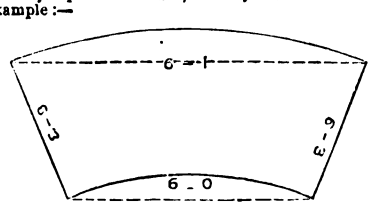
PICTURE CLEANING.—Will any reader inform me how to remove several coats of dirty varnish from a very old oil painting, without injuring the picture?—G. T.

HEALEY'S CHUCK.—In the ENGLISH MECHANIC, Jan. 12, H. H., in answer to X. Y. Z., says, Healey's chuck will answer his purpose for cutting outside and inside wood screws. Will H. H. kindly oblige me with a description of Healey's chuck or where it can be bought?—JOURNEYMAN TURNER.

ELECTRIC MACHINE.—Will some kind contributor furnish me with the title of some practical work upon electro-magnetic, magnetic and magneto-electric machines? I also want to construct a galvanic battery, which shall possess the following qualifications:—Economy, constant and uniform action, capability to exhibit all the usual effects of voltaic electricity, such as chemical decomposition, electric shocks, the electric light, electro magnetism, and electro depositories. I am quite undecided as to what description of battery to employ, as all I know of have some great fault.—BLUNDERER.

SINES OF TEMPLATES.—Will any reader of the MECHANIC give me a ready rule to get at rased sines of templates, of plates for tubes, boilers, &c.?

Example:—



Of course the same rule will apply to all straight cylinders.—CETERATAS.

LIGHTNING.—During one of the late storms, I was struck by the peculiar zigzag form the electric fluid took. Will any of your readers be kind enough to answer the cause of the zigzag, and why not a straight or other direction?—HENRY H. CLAYTON.

SURFACE CONDENSER.—I am much interested in the construction and working of surface condensers, and should feel much obliged to any correspondent who will inform me what are the principal surface condensers now in use, with, if possible, a short explanation of them? I should also like to know the principle of the "vacuum gauge."—VULCAN.

ELLIPSIS.—Will any kind subscriber inform me the readiest and most proper way to strike out an ellipsis?—COMPASS.

CARBON BATTERY.—I should feel much obliged to Mr. Tonkes if he would kindly explain the construction of his carbon battery, size of cells and plates, the excitant used and wheher the carbon is platinised?—W. J. F.

PHOTOGRAPHIC.—Can any reader inform me if there are prepared colours sold for colouring photographs, if not, how am I to remove the greasiness from the photo so as to get the colours to take?—H. P.

GAS BURNING.—Can any one tell me if the Rev. Mr. Buridtch's improvements in gas burning are patented? They are excellent, but I do not wish to encroach on a patent.—T. F.

ACCOUSTICS.—Can any reader inform me of a good treatise on accoustics, one which goes fully into the subject in all its details, or of a work having special reference to the vibration of strings?—J. H., AMATEUR.

GEARING.—Will some person kindly inform me of the difference in construction in the teeth of wheels for heavy and light work?—S. H. H.

PHOTOGRAPHING IN NATURAL COLOURS.—Will any photographic reader inform me how to prepare paper with sub-chloride of silver for photographing in natural colours?—ALPHA.

SEED MACHINE.—Can any reader suggest to me a plan for removing the fruity part of the common "Haw" from the stone or seed, the latter being required perfectly clean?—B.

LUTING CRUCIBLES.—Will any reader inform me how to lute two crucibles together, mouth to mouth, so as to stand the fire?—J. H. M.

TELESCOPE STAND.—Having in my possession an astronomical refracting telescope, 4 feet long, I am desirous of knowing how to make a cheap wooden stand for it, with an equatorial motion. I know the thing can be done, but lack the knowledge how to set about it. If some astronomical or mechanical reader could assist me out of this difficulty I shall feel extremely obliged?—ASTRO.

RAIN GAUGE.—How to construct and use a rain gauge, one that is simple and easily made preferred?—ASTRO.

ELECTRIC CLOCK.—How to make an electric clock, or in what book can I find directions for the construction of one?—ASTRO.

ELECTRIC-MAGNETIC ENGINE.—Would Mr. R. W. Willis be kind enough to explain the letters in the diagram of his engine in No. 46, and what battery he would use? I hope he will pardon my troubling him on the plea that I am only a novice in the science.—ASTRO.

BOILER EXPLOSIONS.—Probably some correspondent will be kind enough to answer the following questions:—Firstly, How is it that we have so many more boiler explosions during the winter than we have in the summer; what is the cause? Secondly, How is it that boilers generally break at the furnace end, or are carried in that direction? Thirdly, Which is the most proper place on the boiler to attach the eduction or steam pipe to, and which is the most suitable place to have the steam and water gauges to indicate the most correctly? Fourthly, Is it safer to have the boiler close to the engine, or, as many have, 20 or 30 yards from the engine?—ENGINE DRIVER.

TESTING HEAT.—Can any person inform me as to whether there is any apparatus by which we could test and actually ascertain the respective quantities of heat emitted from different gas flames, and what kind of burners will cause the flame to emit the most, as I have for the last few years heated a few rooms with gas. I also wish to learn the best practical work on gas, light, and heat?—JOHN KING.

STEAM HAMMER.—Will any correspondent kindly furnish me with an easy rule for a certaining what blow is given by a steam hammer with the steam acting on one or both sides of the piston? A solution of the following will also oblige:—Supposing the weight of the piston, piston-rod, and hammer to be 6 tons 15 cwt., and falling a distance of 4 ft. 3 in., with steam acting on one side only, what blow would it give; and, likewise, what blow would it give with steam acting on both sides of the piston?—ARCHIMEDES.

DAMP ON POLISHED SURFACES.—Having on several occasions had my attention drawn to certain polished cast metal surfaces, on which, under certain atmospheres, I invariably find deposited a damp clamminess, I should feel myself exceedingly obliged if any person would say, through the medium of your paper, to what kind of surface they could give preference as being the least liable to attract damp; that is, whether tinned, japanned, polished, dead, or other, and as to whether it is purely a question of the temperature of the room?—AMOS FLETCHER.

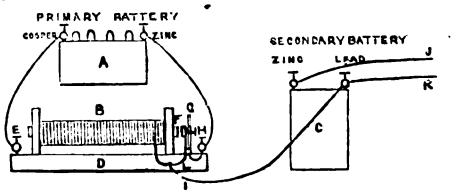
STEEL FOR LATHE MANDRILS.—Can any reader inform me which is the best kind of steel for making lathe mandrils and collars, circular saws, bench spindles, &c.; also the best methods for hardening the same?—GEORGE BOWER.

TOOLS WANTED.—Can you, or any of your correspondents, kindly inform me where I can best procure the tools required for cutting out the bevilled cardboard mounts now so much used for water colour drawings?—M. X.

ALARUM CLOCK.—Can any correspondent tell me of a really good, simple, and effective alarum clock? If so I should be much obliged. I have been much disappointed by those cheap Swiss and American alarums—they are not telling or loud enough when new, and soon lose their voices and become useless.—VERTUMNUS.

REPLIES TO QUERIES.

BATTERY.—I enclose a sketch as requested by your correspondent. It is not necessary that the plates of zinc and lead be rolled up together provided the battery jar is large enough to admit the plan. Your correspondent will find that he cannot roll up amalgamated zinc plates in consequence of their brittleness. With reference to the sketch



A is the primary battery, B, the induction coil, C, the secondary battery, D, stand for the coil, showing the ends of the wire connected to the binding screw, E, on the one side, and the other end connected with the spring of the contact-breaker, F. The other portion of the contact breaker, G, is connected to the binding-screw, H. The zinc of the secondary battery is connected to the binding-screw, H, and the lead connected to the primary coil of wire as shown at I. The connections from the primary battery are from zinc to H, and copper to E. I trust your correspondent will now be able to understand the arrangement, there is nothing very complicated in it. J and K are wires leading from the secondary battery for experiments. I have premised that the coil has been made as given in the sketch; if in any other form the same plan of connections must be adhered to. When setting the machine in operation the screw of the contact-breaker must be brought in contact with the spring portion,

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and as long as the vibration of the contact-breaker continues the operation is going on. The peculiar arrangement of the connections is made in this manner so that we may obtain the extra or dynamic current, which is only produced at each break of the contact-breaker. It will be seen that this extra induced current being in an opposite direction to the inducting primary current passes only in the direction of secondary battery. The formation on the lead of peroxide of lead by the decomposition of the electrolyte causes the immense power of these batteries. It is also well known that two plates of platinum may be used even in the place of lead and zinc, and then the secondary batteries are even more powerful. The power of the platinum batteries depends upon the formation of oxygen on one plate and hydrogen on the other.—ANION.

ALTERING LATHE.—In No. 46, Joseph Shinger asks to be assisted in converting his common foot lathe into a slide lathe. 1st. I suppose he is aware that the mandril must run through the back standard of the headstock for the purpose of placing the first driving wheel upon, which gears into the stud pinion and from thence to the wheel fixed upon leading screw. 2nd. The bed must have a dovetailed top and be planed true. Also saddle to fit upon and traverse to and fro by means of the train of change wheels from mandril. Suppose this done the leading screw should be 1½ or 1¾ inch diameter with two or four threads to the inch, which I should recommend him to get of Richard Lloyd, 135, Steel House-lane, Birmingham, also a set of change wheels, suitable for 6 or 7 inch centre lathes, which will cost, including carriage, about £1'10s. I have had wheels from the above firm and can recommend them, but should advise J. S. to write for a list.—H. GRAY.

DRILL CHUCK.—H. Gray in Number 46 condemns my drill chuck as unfit for carrying ¾ inch drills. Now, I sent my chuck believing it to be required to take the small sets of drills, foot-drills of such sizes as those he mentions, which are usually worked by a brace. Thanking him for his chuck, I am, &c., THOS. E. MERRITT.

MODEL STEAMBOAT.—In answer to P. G. Houlgrave the dots or circles in the drawing of the boiler in Number 44 were intended to show the position of the fire bars. With respect to firing at the proper place I cannot readily remove the deck when furnished with all the fittings, besides it is necessary to put fresh fuel upon the top of that in ignition, and which your correspondent will find rather difficult in so small a model. The distance my boat will run without firing is between two and three hundred yards, and the water must be replenished in about forty minutes.—E. PARR.

SUBSTITUTE FOR SPIRITS OF SALTS.—A week or two ago a correspondent of yours recommended Sir William Burnet's Disinfecting Fluid as a substitute for spirits of salts, adding that the "fluid" was not one-twentieth of the price. As Sir William Burnet's fluid happens to be muriatic acid, or spirits of salts saturated with metallic zinc, it would be funny if it were cheaper than the acid alone. If he had said the acid was one-twentieth the price of the fluid he would have been nearer the mark.—W. PICKARD.

PRESERVING MATHEMATICAL INSTRUMENTS.—A. C. may preserve his mathematical instruments by wrapping them in waxed paper, or dipping them in a solution of bees' wax and turpentine and wiping them dry.—W. PICKARD.

CANADA BALSAM.—Micros can thin his canada balsam by adding spirits of turpentine, letting it stand awhile in a warm place corked up and then stirring it till it unites with the spirit.—W. PICKARD.

STAINING LEATHER.—J. R. S. may stain his leather buff by using turmeric and sugar of lead, but must first free the leather from grease.—W. PICKARD.

TINNING IRON.—A. B. can, I think, cover clean iron with tin by boiling it in contact with zinc in water in which are cream of tartar and tin filings, or grain tin. If not successful, if he will write to me by post I will give him all necessary information.—WM. PICKARD, Meadow street, Sheffield.

LOCOMOTIVE ENGINE.—If W. E. J. will send me his address I will try to give him all the dimensions and information as to how to go about making a locomotive engine with cylinders of the size he mentions.—W. HALLAM, 76, Waterloo-road, Hunslet.

STAIN AND POLISH (No. 44).—1. A mixture of Brazil wood, logwood, and madder dissolved in water and put on hot. The proportions vary according to tint required. 2. A cheap polish:—1 pound of shellac dissolved in 1 quart of wood naphtha. Cost—shellac, 8d., naphtha, 2s. 4d.—J. H.

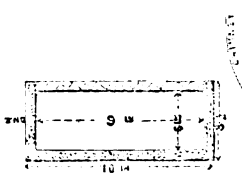
AN UNSUCCESSFUL CHEMIST (MIRROR OF SCIENCE, No. 4) will find the following composition burn under water:—Nitrate of strontia, 8 parts by weight, flowers of sulphur, 3 parts, chlorate of potash, 1 part, and sulphuret of antimony, 1 part. Powder separately, and then mix with a paper-knife, as they are liable to explode if mixed together in a mortar; ram into a strong paper case, varnished to render waterproof, and burn with the mouth downwards. A dangerous compound.—J. H.

CYLINDERS OF MODEL LOCOMOTIVE.—If W. E. J. will send me his address I shall be happy to give him all the information he requires.—THOMAS LISLE, Phœnix Works, Wolverhampton.

ELECTRO-MAGNETIC MACHINE.—Being very desirous of constructing an Electro-Magnetic Machine, I was annoyed to see Mr. Willis's diagram without any explanation, as it debars all who do not understand the subject from even trying. I should be very happy to correspond with Mr. Willis by letter, addressed to C. C. M., 1, South Wharf-road, Paddington.

STAR AND PLANET V. CRANK.—Mr. Thompson ought not to have placed me in a false position before the public by putting forward a statement I did not make. I did not either directly or indirectly venture an opinion on the relative merits of star and planet v crank, nor have I ever used or recommended the former, although some mechanics are apt to think that they are great gainers by such an arrangement. The construction is certainly a very elegant and ingenious one, but with respect to its utility, I think that the crank is preferable, for it is more simple, cheaper, and less liable to get out of order, and takes up less room, while if the fly-wheel is large enough to retain, with less velocity, all the momentum that can be communicated to it, the effect will certainly not be inferior. I may say that I cannot see how the connecting strap is to be dispensed with.—JAMES SHARPE.

VENTILATING.—The most simple method of ventilating any room that has a chimney to it, is the following:—Make an opening in the chimney over the fireplace, and as near the ceiling as possible, about 9 in. by 2½ in., then procure a piece of perforated zinc, 10 in. by 3½ in. and a piece of oiled silk or calico 9in. by 3 in.; fasten the silk or calico to one edge of the zinc by sewing it through the



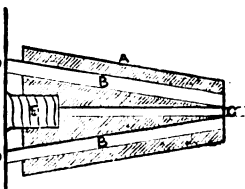
holes; it will then hang loose on the zinc as on a hinge, but it will not reach the ends or bottom edge by half an inch; now fix the zinc over the hole, with the flap inside, (not in the room) and with the edge that is secured uppermost. A strip of paper bordering may be pasted on the wall, and partly on the place, to hold it. The up draft will blow the silk back, but the down draft of the chimney will close it. I am much obliged to Mr. Tonkes. I shall adopt his plan. Also thanks to T. K. K.—CARBON.

HORSE POWER.—W. H. (No. 41) can find the horse-power of his engine, when working at any given rate, from the answer to "Erino" in No. 42. This by 6 35 will give the number of gallons of water evaporated per hour. An engine requiring 1 cubic foot = 63 5 lbs. = 6 35 gallons per horse power, per hour.—J. H., AMATEUR.

CYLINDER (No. 42)—Greer in his "Mechanic's Calculator," gives the following formula:—"Pressure per square inch by radius of cylinder, cohesion of metal per square inch—pressure = thickness of metal necessary for the cylinder to sustain the pressure, the pressure being in pounds." The cohesive force of a square inch of cast iron being 18,000 lbs., we have—

$$\frac{560 \times 2{\cdot}25}{18{,}000-560} = {\cdot}0072 \text{ inches.}$$—J. H, AMATEUR.

CONCENTRIC CHUCK.—I forward a Concentric Chuck for holding wire—the simplicity of which is self-evident. A is a brass cone, which is adapted so as to fit the lathe spindle screw, and the centre line is bored to the size according to work. B, B are two spindles running parallel to the water line of A, which meet at the centre C, for the grip



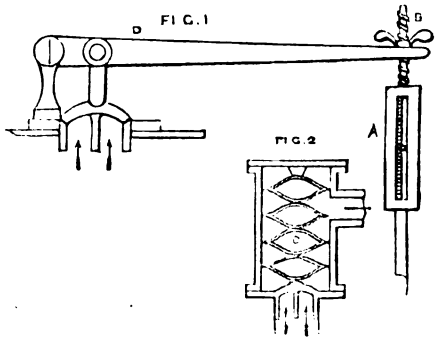
holding the wire. The gripping power is derived from the lathe and spindle screw E, by having the cone A, screwed on and bringing the spindles B, B against the shoulder D, so forcing the spindles forward to the gripping point C. The chuck won't get loose, as the cutting power acts as a screwing power to keep it in its place.—PARATUS AD ACIEM.

PLASTER CAST.—A correct cast cannot be taken from a living person, in consequence of the flesh shifting about with the weight of the mould. I have taken 3 casts of human faces after they have been dead, in the following manner:—I first soaped the hair well, then I placed it in the form that the deceased usually wore it; I then oiled the skin with sweet oil, and formed the fence with clay and powdered the Plaster of Paris into water in a basin; I then covered the face with it, and removed the clay and followed the usual form round the head. Here is the plan that I once adopted to take a cast of a man's face alive. I took some tracing paper and oiled it, and placed it on the face, first stopping up the nostrils with clay soaked in oil, and placed two goose quills in the nostrils, for breathing through. I then prepare my mould for casting, after I have taken my mould of the human face, in the following manner:—I make the mould hot; I then take some Russian tallow, and melt it, and with a painter's brush I cover the inside of the mould until it will not take any more grease. It is then ready to cast. I should recommend J. S. to practise upon other objects before he undertakes to cast from a living face.—HENRY THOMAS.

IODIZED COLLODION.—If a correspondent (page 253) who signs himself D. W. will get some newly Iodized Collodion, he will not find his varnish dissolve the films as stated. I was very much troubled the other week with the same thing. I tried different developers all to no purpose. I then took some newly iodized collodion (Manson's, which I think is the best in the market), tried a plate, and all went off quite right. I believe the age of the collodion was the cause of the film dissolving, as I had been using the same collodion with good success some weeks previous.—S. ARLIDGE.

FOCUSSING SCREEN.—Perhaps some of my brother amateur photographers would be glad to learn how to be able to grind a focussing screen, as it is probable that they may have the bad luck to break theirs, and not be able to get at one handy. The following plan will enable them to grind one as fine and nice as any to be obtained in London. Take a piece of patent plate glass, the size you require, lay it down on a perfectly flat bench or board, and drive a small tin tack or two on each side of the glass to keep it in place; then take a pinch of the Wellington knife powder (of which a canister can be obtained of any ironmonger for 6d), which will be enough to grind a score of screens; apply the powder to your glass with a few drops of water, and mix till about as thick as cream; then take a piece of thick plate glass about one inch square, and grind the surface of your glass with a regular motion of the hand slightly bearing on till you get a good face, which will take from half an hour to 1½ hours according to the size of screen; apply fresh powder and water at times, and, to see how you are getting on with it, wash in clean water, and dry very steadily before a fire, or in the sun, and if the screen has not a nice regular clean face apply the same means over and over again if required till you get it to your mind, but do not put on any fresh powder in the finishing for the last quarter of an hour, as it will give a finer surface. I am a practical camera maker, and this is how I grind mine.—S. ARLIDGE.

SAFETY VALVE BALANCE.—At the request of W. Longton, I send a rough sketch of the safety-valve and balance, which is now used on the principal railways. The lever D, Fig. 1, is affixed to a spring-balance A, graduated to the pressures per square inch due to the spring. By turning a nut Bon the stem of the spring-balance any required pressure can be thrown upon the valve, which is kept down by the spring acting on its lever. Should the pressure within the boiler exceed that to which the balance is adjusted, the valve is opened, and a portion of the steam escapes. The lock-up safety-valve, Fig. 2, consists of a valve pressed down by a set of strong springs C, the whole enclosed within a box under lock and key. While the engine-driver has command over the spring-balance valve, so as to increase



or diminish the load at pleasure, the lock-up valve is inaccessible to him, and opens whenever he has loaded the open valve beyond the pressure to which the lock-up valve has been adjusted; thus serving as a check upon him in case of his working at a dangerous pressure.—J. K. K.

TO GET UP BRASSWORK.—The following are two good processes:—Firstly—Beat some sal ammoniac into a fine powder, and moisten it with a little soft water. Rub this on your work, which must be heated over charcoal, and afterwards rub dry with bran and whiting. Secondly—Wash the work with roche alum boiled in strong ley, in proportion of one ounce to a pint; when dry it must be rubbed with fine tripoli. Either of these processes will give to brass the brilliancy of gold.—J. K. K.

POLISHING LENSES, MICROSCOPES, &C.—A. M. (page 199) will find full particulars for grinding and polishing lenses, at page 77, No. 33 of the MECHANIC. He may rely on their practicability. It is the way I have worked, as an amateur, for many years, and have produced lenses for the microscope, telescope, and photography. The large size lenses require an apparatus for grinding. I fitted up a contrivance for it, but I always polish by hand. Page 220, Power of Microscope—To swell the magnifying power, opticians give the value in square numbers (superficial measurements), not linear, therefore 6,000 times is equal to about 80 times. In all cases find the square root of the power given, and that will be the true linear magnifying power. To prove the correctness, place a foot rule 10 inches from the eye-piece, and whilst viewing the object with one eye, look at the rule with the other, when the image of the object will be seen on the rule. Note the number of inches or parts it occupies, and then measure the size of the object, the increase will show the power. Example—An object measuring one-tenth of an inch, if its image occupy 2 inches the power is 20 times. A good guide is a micrometer slide ruled to 100 and 1,000 lines to an inch.—YSXAX.

FIXING A PICTURE.—In "Notes and Queries" of No. 43, E.M., I see M. C. wanting to know the chemical changes which occur when taking, developing, intensifying, and fixing a picture in photography; as a lucid explanation of the hypothesis, or rather hypotheses, as several are advanced, would take up too much of your space except in the form of an article on photography, which probably will be given sooner or later in the ENGLISH MECHANIC by some of our practical photographers, I will just refer M. C. and all other readers seeking the same information to a shilling work, published by Cassell, Petter, and Galpin, called the *Catechism of Photography*. The price is not much, and it explains the subject as clearly as I think it is possible to be explained.—THOMAS PEASE.

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ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

J. B. (Wednesbury).—No advertisement or postage-stamps received, or would have been inserted. Are you sure you addressed correctly?

THOMAS PEASE.—We shall be glad to receive the article at any time.

HENRY THOMAS.—You had better advertise. We do not know of any merchants in your neighbourhood.

A. CRANSTON.—We have never seen such an instrument and should think it well worth a patent.

CRANK SHAFT.—All your arrangements seem well planned and deserve success. Let us know the result.

PETER HENDERSON.—We shall be glad to insert whenever you can spare time to forward the article.

ELECTRO.—Read the article commenced in the present number.

MACHINIST.—The numbers will be reprinted in a month or two.

D. V. L. C.—The question has quite slipped our memory. Write again and we will endeavour to answer fully.

GEORGE BOWER.—Write to Mr. W. H. Pearce, 77, Great Suffolk-street, Borough.

TISSERAND.—We will endeavour to procure the information, but if it is a French patent it may be difficult to do so.

J. H. L. (Leeds).—There is a work that may answer your purpose published by Blackie, of Paternoster-row. It is being published in parts.

WILLIAM GREEN.—Articles will shortly appear.

A CONSTANT READER.—Write to Mr. Thomas Lisle, Phœnix Works, Wolverhampton.

R. ROSS.—We have not been able to obtain the information. Why not write to some of the Sheffield Steel Works?

J. R. EVANS.—Your question on bronzing has been often answered in these pages. For your second question see replies in present number.

JASE T. LATHE.—Write again.

BRITTAIN and WILLIAMS (Bilston).—We know of no particular rules, but we shall give next week portions of a small road locomotive just constructed by Mr. A. W. Forbes. We cannot send answers by post, but will try our utmost to give you all the information you require in these columns.

ANTHRACITE.—1. Of any manufacturing chemist. 2. We endeavour to make everything as clear as possible and to answer questions so far as space will permit, but we cannot invent new names for chemicals, because a few of our readers happen to be ignorant of the terms in general use. The labour would be mostly thrown away, while the space wasted would be great.

ROBERT ALEXANDER.—We have not yet received an abstract of the paper, but expect to do so shortly.

ERRATUM.—No. 46. p. 278, middle of 1st. col., for "sufficient" read "supposed."

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

MEETINGS FOR THE WEEK.

TUESDAY.

Civil Engineers, 8. Statistical, 8. Colonel Sykes, M.P., F.R.S., "On the Organisation, Strength, and cost of the French and English Navies in 1865." Pathological, 8. Anthropological, 8. Royal Inst., 3. Professor Tyndall, F.R.S., "On Heat."

WEDNESDAY.

Society of Arts, 8. Mr. Thomas Grey, "On Modern legislation in regard to the construction and equipment of steamships." Meteorological, 7. 1. Mr. C. O. F. Cator, "On daily weather diagrams, 1865." 2. Mr. G. J. Symons, "On the fluctuations of the annual fall of rain." Geological, 8. 1. Mr. R. Lechmere Guppy, "On the Tertiary Mollusca of Jamaica." Communicated by Mr. H. Woodward. 2. Mr. R. Lechmere Guppy, "On the Tertiary Echinodermata of the West Indies." Communicated by the Assistant Secretary. 3. Mr. R. Lechmere Guppy, "On the Tertiary Brachiopoda of the West Indies." Communicated by the Assistant-Secretary. 4. Mr. J. Young. "On the affinities of Platysomus and allied genera." Communicated by Prof. T. H. Huxley, F.R.S. 5. Dr. John Young, "On the scales of Rhizodus. Owen." London Institution, 7. R. Society of Literature, 8½. Archæological Society, 8½.

THURSDAY.

Royal, 8½. Antiquaries, 8½. Philosophical Club, 6. Royal Inst., 3. Professor Tyndall, F.R.S., "On Heat."

FRIDAY.

Royal Inst., 8. Mr. Wm. Pengelly, "On Kent's Cavern, Torquay."

SATURDAY.

Royal Inst., 3. Professor Westmacott, R.A., "On Art Education and how works of Art should be viewed." Royal Botanic, 3½.

DESULPHURISING ORES.—Messrs. Tait and Avis, of New York, have patented the process of desulphurising sulphurets by a current of heated compressed atmospheric air, impelled by a suitable pump, in combination with a closed furnace containing the ore.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

363. Robert Gatley, Manchester, improvements in blowing or blast engines.
364. Richard Clark, Pinner, improvements in the construction and lighting of railway carriages.
365. Thomas James Smith, Twickenham, improvements in lubricating the axles and bearings of railway rolling stock and other machinery.—A communication.
371. Charles Denton Abel, 20, Southampton-buildings, Chancery-lane, improvements in the means and apparatus for regulating the supply of steam to stationary, locomotive, and marine steam engines.—A communication.
375. Joseph Lewis, Manchester, improvements in meters for measuring and registering the flow of liquids, part of which improvements is also applicable to regulating the flow of steam.
377. Alexander Clark, Rathbone-place, improvements in machinery or apparatus for mortising or cutting holes or mortises in wood.
383. Pierre Alexis Francisse Boboeuf, Paris, improvements in the manufacture of artificial coal tars and their solid derivatives, such as phenical soaps and salts.
389. Robert Bond and William Joseph Bussell, an improved substitute for emery to be used for cutting, grinding, and polishing metal, marble, glass, precious stones, and other hard substances.
391. John Roe, Birmingham, an adjustable lever spanner or screw wrench.
394. Henry Edward Francis de Briou, 19, Marlborough-hill, St John's Wood, improved compositions for preserving metals from oxidation, corrosion, and galvanic action, for protecting metals used in the construction of ships against the destructive effects of sea water, and preventing their fouling, for protecting wood from the attacks of animalculæ, and preserving wood from damp, rot, and decay, for excluding damp from walls, and for use in submarine and other telegraphy.
396. John Henry Dallmeyer, 19, Bloomsbury-street, an improved photographic lens.
398. William Robert Lake, 8, Southampton-buildings, Chancery-lane, an improved apparatus or machine for removing the seeds or stones from raisins and other dried fruit.—A communication.
399. Edward Bevan, Birkenhead, improvements in the construction of furnaces and kilns employed in the manufacture of glass, and in the heating and burning of articles of glass and earthenware.
402. Robert Williams Armstrong, Belleck, Fermanagh, improvements in preparing clay dust and similar materials for making earthen and other ware, and in machinery for moulding hollow articles in earth, clay, and other like materials.
417. John Binns and William Binns, Halifax, improved machinery or apparatus to be employed in the manufacture of Jacquard wires used in looms for weaving.
419. Henry Charles Clifton, 44, Rahier street, Clerkenwell, improvements in machinery for laying veneers on to surfaces.
423. John Pinches, 27, Oxenden street, improvements in stamping or embossing presses used for embossing, coining, or stamping of devices of any kind on metal, parchment, paper, or fabrics of any kind.
441. James Atkinson Longridge, Abingdon street, Westminster, improvements in apparatus for facilitating the working and discharge of ordnance below the water level.

LIST OF SPECIFICATIONS, &c. PUBLISHED DURING THE WEEK ENDING 10TH FEBRUARY, 1866.

611. Obtaining motive power from ammonia, R. A. Brooman—1s. 8d.
615. Tobacco charges, W. E. Newton—1s.
618. Photographic pictures, E. Pettitt—4d.
619. Giving electric signals for the protection of property, C. F. Varley—8d.
642. Breech-loading fire-arms, F. Tolhausen—1s. 8d.
643. Marine steam engines, J. Dean—10d.
644. Cutting and shaping metals, making nails, &c., Joseph and James Wadsworth—4d.
645. Preserving meat, A. C. Henderson—4d.
646. Stoppers for bottles, &c., G. Ireland—4d.
647. Packing, F. Wise—6d.
648. Watercloset apparatus, J. Shanks—10d.
649. Converting cast or pig iron into wrought iron or steel, M. Morgans—2s.
651. Motive-power engines, W. Clark—6d.
652. Grinding corn, &c., F. W. Turner—1s. 4d.
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659. Revolving fire-arms, W. Clark—1s.
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Reversionary life interest of a gentleman aged 35 years, in £14,333 6s. 8d. consols—sold for £1,600.

An annuity of £300 payable to a gentleman aged 35 years during the life a lady aged 65 years, also the life interest of the same gentleman in the dividends derived from £7,476 12s 8d. consols, payable in the event of his surviving his wife, aged 32 years—£800.

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Leasehold improved ground rent of £7 per annum, arising out of "The Two Eagles" beer house, three shops adjoining, and three houses at the rear, situated in King-street, Old Kent-road—£50.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Erection of station and other buildings for the London Brighton, and South Coast Railway. Particulars of F Slight, Esq., Secretary, London Bridge Terminus.

Supply of building materials for repairs of Convict Prisons. Particulars at the office, 45, Parliament-street, Westminster.

Contracting with the Luton Local Board of Health, for providing and laying York paving, Denner-hill channelling, and York Curle, and also for levelling and metalling roadways. Particulars of Mr. Sandoe, 15, Stewart-street, Luton, Beds.

Erection of a pair of Italian semi-detached villas, on the Coldrington road, in the borough of Bedford. Particulars of Mr. Usher, 44, High-street, Bedford.

Ceylon Railway.—Rails.—Required, by the contractor for this railway, 670 tons of rails, to be delivered (f. o. b. Thames) within three months. Particulars at the contractor's office, 13, Southampton-buildings, Chancery-lane, February 12th, 1866.

Erection of a new church at Selby, York. Particulars of Messrs. Newstead and Son, 21, Colney street, York.

TENDERS SENT IN FOR BUILDING WORKS.

A villa residence at East Leake, Notts. Messrs. Shenton and Baker, architects, Liecester:—Porter, £4,150 10s.; Bland, £4,145; Neale and Sons, £3,900; Osborne Brothers, £3,825; Hutchinson and Son, £3,132 19s.

Elastic web factory, Brougham-street, Liecester. Mr. W. S. Burton, architect:—Wright (accepted), £738 4s.

New schools for St. John's Church, Battersea. Mr. G. U. Page, architect:—Cresswell, £1,863; Mulliner and Cooper, £1,820; Palmer, £1,819 10s.; Gammon and Sons, 1,775; Newman and Mann, £1,756; Lathey, Brothers, £1,730; Champion, £1 557; Bass, £1,520.

For a pair of semi-detached villas at Low Layton. Mr. T. J. Hill, architect:—Larke, £1,673; Turner and Sons, £1,933; Webb and Sons, £1,631; Rivett, £1,593; Anley, £1,554; Martin, £1,520; Hunt, £1 493.

Alterations to Simpson's Hotel, Strand. Messrs. Finch, Hill, and Paraire, architects:—Simpson, £8,050; Browne and Robinson, £7,950; Myers and Son, £7,775; Killby, £7,720; Holland and Hannan, £7,672; Brass, £7,143.

For sewers in North-street and Lower North-street. Mr. Joseph Pattisson, surveyor. Neave (accepted), £869.

For two houses, Clyde-street, Leicester, for Mr. J. H. Buckley. Mr. W. S. Burton, architect:—Flude (accepted), £370.

For factory and dwelling house, Grafton street, Leicester, for Mr. W. Raven. Mr. W. S. Burton, architect:—Johnson (accepted), £830 4s. 6d.

For alterations, &c., at Wesleyan Chapel, Thurmaston, Leicestershire. Mr. W. S. Burton, architect:—Groves and Son (accepted), £150.

COMPETITION OPEN TO ARCHITECTS.—Designs for a new building for the Bolton Mechanics' Institution. Particulars of Edward Barlow, Esq., Oxford-street, Bolton.

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LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
COPPER.							
British—cake and tile	per ton	96	0	0	0	0	0
Sheet	do	99	0	0	101	0	0
IRON.							
Pig in Scotland	per ton.	3	9	0	cash.		
Welsh Bars, in London	do	7	15	0	0	0	0
Wales	do	6	15	0	7	0	0
Staffordshire	do	8	10	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
LEAD.							
Pig, Foreign	per ton	20	10	0	20	15	0
Red or minium	do	22	10	0		—	
QUICKSILVER	per bottle	7	15	0	7	17	6
STEEL.							
Swedish faggot	per ton	0	0	0		—	
,, Keg	do	15	10	0	16	0	0
TIN.							
English Blocks	per ton	95	0	0		—	
,, Bars	do	96	0	0		—	
Banca	do	86	0	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.		£	s.	£	s.
Teak	11	10	12	10	Canada, 2nd qual.	12	10	14	0
Quebec, red pn.	3	5	4	15	St. Petersburg yel.	10	10	12	0
yellow pine	2	15	3	10	Finland	8	0	10	0
Memel	0	0	0	0	Memel	0	0	0	0
elm	3	10	5	0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Dantzic oak	3	10	6	0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	6
fir	2	5	3	10	Staves, per standard M.				
Memel fir	3	0	3	10	Quebec, pipe	80	0	85	0
Riga	3	5	3	10	puncheon	20	0	25	0
Swedish	2	0	2	10	Baltic crown pipe	170	0	190	0
Masts, Quebec, rd. pine	6	10	8	10					
yellow pine	5	0	6	0					
red pine	0	0	0	0					
Lathwood, Dant. fm	5	10	6	10					
St. Peter's	7	0	8	0					
Yellow Pine, per reduced C.									
Canada, 1st qual.	17	0	19	10					

MISCELLANEOUS.

	£	s.	£	s.		s.	£	s.
PUMICE STONE pr ton	5	0	8	0	Olive, Gallipoli	56	0	0
OILS, &c.					Cocoanut, Coch. ton	51	0	52
Seal, pale pr. tun	50	0	0	0	Palm, fine	41	10	0
Sperm body	116	0	117	0	Linseed	36	10	0
Cod	51	0	0	0	Rapeseed, Eng. pale	56	0	57
Whale, 8th Sea pale	48	0	50	0	Cotton, seed	34	0	40

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WATCHES and Clocks (English and Foreign).—The advertiser, having had great experience in the above, wants employment; Piecework. W., 556, Old Kent-road.

WATCH-CASE Makers.—Apply, C. Jackson, 5, President street East, King-square.

HARMONIUM-CASE Maker.—Apply, 49, Church terrace, Kentish Town-road.

SEWING Machines (Thomas's).—A young Man, who thoroughly understands making, repairing, and adjusting Sewing Machines, is in want of a Situation; or improver to the Engineering. J. G., 5, Twyford's-buildings, Little Queen-street, Holborn.

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MEDAL STRIKER, to Strike Medals and Polish Dies.—Address Mr. Brown, Medal-court, Crystal Palace, Sydenham.

DIE SINKERS WANTED at once; good hands, used to the lettering, &c.—Apply to B. SULMAN, 177, Upper Thames-street, E.C.

IRONMONGERS' ASSISTANT—a Junior Hand. He should have had some practice in drawing. Apply by letter only to Mr. C. HART, 70, Brook-street, Hanover-square.

CHEMISTS' ASSISTANT—a Laboratory Man.—Apply, 3, White street, Little Moorfields.

ENGRAVER—a Writing Engraver.—Apply at G. COOK'S, 44, Rupert-street, St. James's, W.

LITHOGRAPHIC PRINTER; constant employment. Apply at MARTIN and HOOD'S, 8, Great Newport-street, Soho, W.C.

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MAP ENGRAVER.—Apply to Mr. Brown, 5, Trinity-place, Charing-cross.

TINMAN. Wages 30s. a week.—Apply to Mr. Cornick, Ironmonger, Hampstead.

MOULDING MACHINE WORKER.—Apply at 28 and 29, Great Sutton-street, Clerkenwell.

JEWELLER.—A young man, used to light gold Earring Work. 22, Clerkenwell-green.

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JEWELLER.—Mounter wanted. 4, Bartlett's-buildings, Holborn.

JEWELLER.—A good polisher. Apply 2, Newcastle-place, Clerkenwell-close.

MATHEMATICS. A Tutor.—Address, Omega, Mr. French's, librarian, No. 70, Park-street, Camden-town.

BOOK MOUNTER. A good Saw Piercer.—Apply in Counting house, 16, St. John-street.

BOOKBINDER. One who can block.—Richmond & Son, 3, McLean's-buildings, New street-square.

POLISHER (French). One used to small work.—51, Great Sutton-street, Clerkenwell.

BLOCK CUTTER.—Apply, John Crawley & Son, 66, Wood-street, City.

WHEELWRIGHT (Journeyman).—Apply to Mr. Wall, Wheelwright, North-street, Barking.

BRASS CASTER.—Apply to George Glover and Co., Ranelagh-road, Pimlico.

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ENGINE and Boiler (Small) in good condition, wanted. Particulars, letters only, to Mr. Cook, 40, Maiden-lane, Covent-garden.

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BOOK-CASE, containing three or four compartments. State height and price, to Mr. Roberts, 1, West Smithfield.

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To Exhibitors.—Contributions of Skilled Workmanship, or Amateur Productions, will be accepted from all parts of London, the Provinces, Scotland, Ireland, and the Colonies. For the benefit of Provincial Exhibitors, the railway companies have liberally offered to return unsold goods free, so that the expense of carriage will be but half the usual charge.

Prize Medals, regulated in value according to the success of the undertaking, will be awarded for the most meritorious productions.

The Sale of Articles exhibited will be especially encouraged, and the price, if desired, may be affixed to the objects. An office will be opened in the building for the transaction of this business.

The Great Hall the largest in London, will be fitted up for the display of industrial objects, no charge being made to exhibitors for occupying space.

Small Workshops, with and without steam power, will be fitted up round the building. These will be let, under special arrangement, to persons who may desire to manufacture and sell articles during the Exhibition.

The Minor Hall will be used as a Picture Gallery and Fine Arts Court, furnished with chairs and tables, and supplied with the Daily Papers, Magazines, &c., for the accommodation of visitors during the day. The Lords of the Committee of Council on Education will contribute to this department a full illustration of the instruction afforded in Government Schools of Art throughout the United Kingdom.

A Lecture Hall will be constructed, capable of accommodating about 3,000 persons This will be devoted to the following, among other purposes:—

Lectures.—The delivery of a series of Lectures upon subjects of interest, in harmony with the objects of the Exhibition.

Conversazione, &c—It is contemplated to grant the use of the Lecture Hall to Trade and other societies, for the purpose of enabling workmen to invite employers or friends to conversational meetings: also, under special conditions, to Amateur Musical Associations. The National Temperance League, and several other societies, having for their aim the advocacy of the social interests of the industrial classes, will organise demonstrations for particular days.

Flower Show.—Facilities will be afforded for holding a Flower, Fruit, and Vegetable Show, in connection with the various existing Amateur Horticultural Societies in the Metropolis.

A Temporary Garden.—It is contemplated to lay out a space of open ground adjoining the Hall as a small garden. This will afford an opportunity for the proper exhibition of terra-cotta borders, rustic seats, &c.

Schools.—It is intended to invite the whole of the school children in the Metropolis and adjacent districts to a free inspection of the Exhibition. The North London Auxiliary of the Sunday-School Union have arranged to occupy a space with objects made by the children connected with the schools in their district.

Choral Societies.—The musical entertainments will be chiefly confined to societies supported by the working classes. Arrangements have been made with the Tonic Sol-fa Association to organise six concerts of 1,000 voices each; and the Band of Hope Union, dividing their children into choirs of 1,500 strong, will also afford musical entertainment on several evenings. The instrumental music will be supplied by the volunteer, police, and other existing sources, and varied by occasional performances on the Great Exhibition organ.

ART AND INDUSTRIAL UNION.

In order to facilitate the sale of articles which Exhibitors may desire to dispose of, application will be made to the Board of Trade for special authority to legalise the issue of shares in the same manner as that adopted by the various art unions now in existence.

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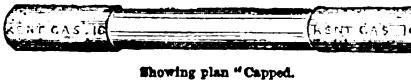

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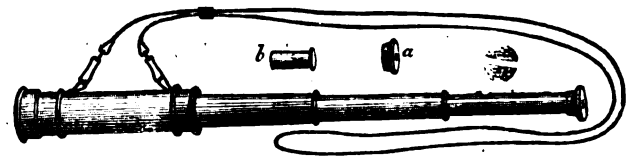

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ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

A JOURNAL DEVOTED TO THE INTERESTS OF ALL CONNECTED WITH ENGINEERING, BUILDING, NEW INVENTIONS, MANUFACTURES, METALS, PHOTOGRAPHY, CHEMISTRY, TELEGRAPHY, ASTRONOMY, ELECTRICITY, &c.

VOL. II.—No. 49.] FRIDAY, MARCH 2, 1866. [PRICE TWOPENCE.

FIG. 1.

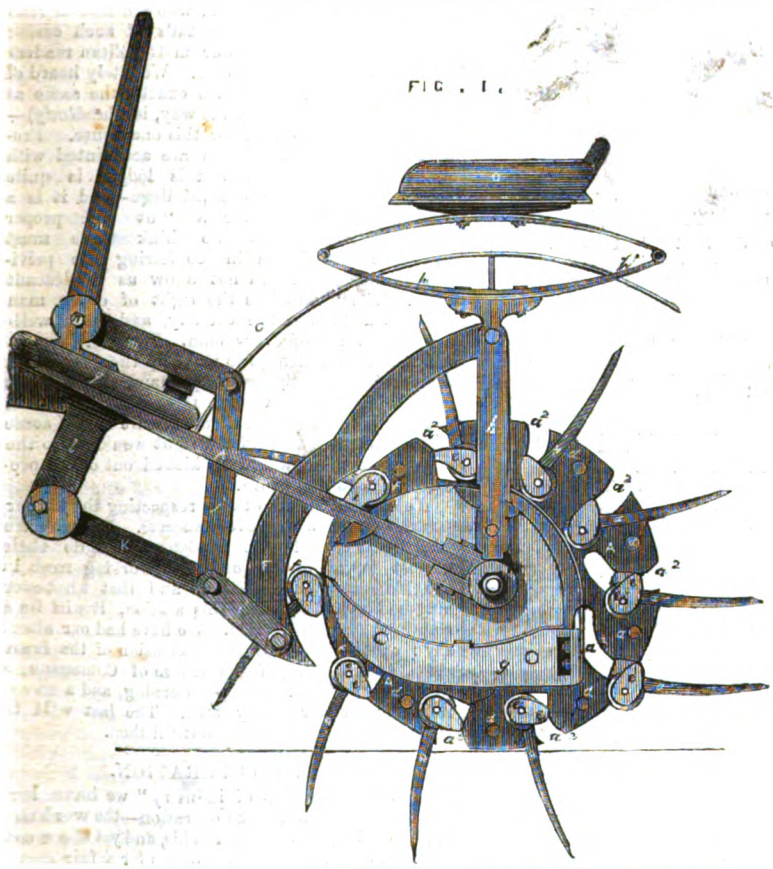
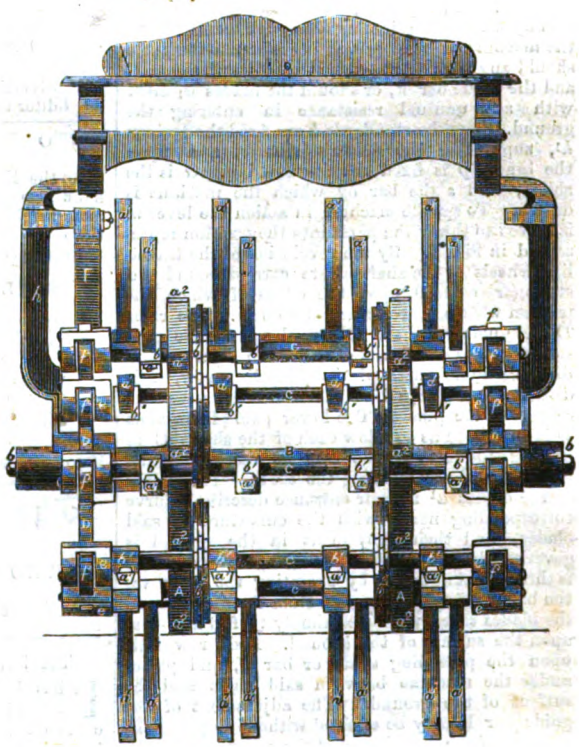


FIG. 2.



PHILLIPS'S IMPROVED ROTARY SPADER OR DIGGING MACHINE.

THE nature of the invention which forms the subject of our illustrations, consists chiefly in so constructing and arranging the working parts, that by the forward movement of the machine the fork tines or spading blades, which are connected to the travelling wheels, and partially controlled by fixed or stationary cams, enter the ground as they revolve, thereby, it is claimed, effectually and speedily lifting, breaking, and pulverising the soil. The invention, we may state, is patented for Mr. Comstock, of Milwaukee, U. S., by Mr. Phillips, of 15, Chancery-lane, London. Fig. 1 is a side elevation of the machine with the parts in position to cause the forks to enter the ground; and Fig. 2 is a back elevation with the forks in the same position.

The travelling wheels A are fixed on the main axle B, by keys driven toward the centre of the machine and cut off flush with the end of the hubs, which are turned to fit in recesses in the bosses of the stationary cams D. The nuts *b* hold the cams D in their places, and effectually exclude all dirt from the axle journals. The fork blades a^1 are sharpened at their points, and are attached to the shafts C, so that each row when closed will fall and lie between those of each preceding row. The shafts C are of such a section as to fit into a recess formed in the head of each of the blades a^1, and these blades are fitted in their respective positions on said shafts, and secured thereto by straps b^1 and keys *c*. The strap b^1 being first placed on the shaft C, the head of the tine or blade a^1 is then inserted in the slot in said strap, so that the recess in the head of the blade fits on the shaft. The keys *c* being driven tightly between the head of the blade will draw the strap b^1, shaft C, and blade *a* firmly together. By this means the blades a_1 can be easily removed when required. The shafts C are suspended by arms b_2 upon pins *d* fixed in the wheels A, near their perimeter. These shafts project beyond the wheels A, and on their projecting ends are fixed brackets *e*, in the jaws of which are fitted the pins e^1 for carrying the friction rollers *f*. The grooves or recesses a_2 formed on the wheels A are of such a shape as to correspond with the curve described by the movement of the shafts C, thereby allowing the shafts to vibrate freely on the centre pins *d*, and be guided by the

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cams D, while at the same time they are firmly sustained in the position required to force them to enter and effectually break up and turn over the soil. The stationary cams D in connection with the adjustable guide bar F, guide the movements of the shafts C, and consequently the action of the blades a^1. These cams D, in which are formed the bearings for the axle B are prevented rotating with the axle by being fixed to the bars *p* and other parts of the machine, and are for convenience and economy constructed in two parts. The lower part or shoe *g*, which regulates the action of the blades a^1 in the ground, is preferably made of chill-hardened iron, and is secured to the upper portion g^1, so that it can be easily removed. The lower end of the said shoe should be formed nearly straight, to obtain the most advantageous movement of the blades a^1 while in the ground. The springs E attached to the cams D are provided to ease or break the fall of the shafts C whenever, by a quick movement of the team, said shafts are thrown out behind. The adjustable guide bar F is pivotted at its upper end to the standard *h*, and at its lower end to the link *i*. To the opposite end of the link *i* are pivotted the links *j* and *k*, the upper end of the latter being pivotted to the hanger or bracket *l*. The upper end of the link *j* is connected to one end of the elbowed lever *m*, working on the fulcrum pin *n*. By this construction and arrangement of the lever *m*, links *i*, *j*, and *k*, and guide bar F, the working of the machine is controlled by the driver, while the guide bar F is sufficiently self-adjusting to allow the blades a^1 to fold up when there is any excessive strain upon the machine, thereby preventing injury to the parts should any hard substance get between the cam D and the guide bar F, or should the blades a_1 meet with any unusual resistance in entering the ground. Upon the standards *h* are fixed the springs h^1, supporting the driver's seat *o*, and upon the braces *p* is fixed the footboard *q*. G is the shield, and *s* the bar by which the machine is drawn. To set the machine in action the lever *m* is moved to throw the parts into the position represented in Fig. 1. By the revolution of the travelling wheels A, the shafts C are carried round the stationary cams D, upon the edges of which the friction wheels *f* are arranged to run. The cams D and guide bar F are so shaped as to cause each row of blades a^1 to strike the ground at a certain distance in advance of the preceding row, this distance being equal to the space between the centres of the pins *d*. The lower part of the cams D is so shaped as to allow each of the shafts C in passing around to recede into its recess a^2 while the blades a^1 are entering the earth. The points of the blades a^1 in their entrance describe a curve corresponding nearly with the curvature of said blades, and their movement in the ground is governed by the shape of the shoe *g*. The machine is thrown out of action by operating the lever *m*, the bar F being drawn away from the cam D, and the blades thereby allowed simply to fall and rest upon the surface of the ground. Each row falls upon the preceding shaft or bar C, and passes under the machine between said shaft and the surface of the ground. The adjustment of the guide bar F may be effected without stopping the rotation of the machine, and the machine may be conveniently drawn along without injury to the blades a^1 or other parts.

Testimonial. — Mr. W. T. Baker, forge manager, has been presented with an elegantly chased silver snuff-box, and a pair of gold spectacles, on his leaving the Gateshead Park Ironworks (Messrs. John Abbot and Co.) The chair was occupied, and the presentation made, by Mr. George Henderson, manager.

Cornish Pumping Engines. — The average duty of 31 Cornish pumping engines, of which the performances were reported in December, was 50,900,000 lb. raised one foot high by 112 lb. of coal. Putting this into horse-power per hour, it is equal to 4·35 lb. of coal per effective (not indicated) horse-power per hour. In point of economy of fuel the Cornish engines have for some time been surpassed by many large marine engines, and by several varieties of land engines.

THE ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART.

TWOPENCE WEEKLY.

No. 47, Feb. 16.—Messrs. Woodward's Improvements in Melting and Smelting Furnaces, with Illustrations.—Telegraphy.—Electro-Metallurgy.—A New Analine Black.—Improvements in Regulating and Working the valves of Steam Engines, with Diagram.—London Association of Foremen Engineers.—New Atmospheric Insulator, with Diagram.—Marine Engineering.—The Steam Fire Engine, with Illustrations.—The use of the Lathe, with Illustrations.—Cooling and Freezing, with Illustration.—The Original Screw Propeller.—Letters to the Editor.—Notes and Queries.—Replies to Queries.—And many original and selected articles of value, alike to the amateur in Science and Art and the Working Mechanic.

No 48, Feb. 23:—Wilson's Injecting Lubricants into Cylinders, &c., Illustrated.—Sewage.—The Art of Coining.—Electro-Metallurgy, Illustrated.—Timber suitable for Building Purposes.—Action of Light on Naphthaline. Valves for Docks.—Practical Photography.—Animal Magnetism.—Art Notes.—Telegraphy.—Scientific Notes.—A Substitute for the Position Microscope.—The Lathe and its Uses.—Safety Valves for Steam Boilers.—Chloroform for Removing Stains of Dry Paint, and much other useful information.

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The English Mechanic,

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MIRROR OF SCIENCE AND ART.

FRIDAY, MARCH 2, 1866.

THE WORKING MAN'S FRANCHISE.

It has been urged upon us by many that we should "pronounce" as to the franchise—come out in politics, at least so far as is covered by the above heading. We are not politicians—it is not exactly our *forte*, but, for once, we step into the arena, to say our say, and retire for awhile. As at present constituted, then, we believe the House of Commons to be simply a big railway board, with a sprinkling of large manufacturers, lawyers, "philosophers," and military and naval men; the majority, with some particular "interest" to look after which is not the interest of all. If we are to have reduced the tremendous expenditure now going on—to consult economy, and have our business conducted in a thorough business-like manner, there must be a thinning of the family and trade interest in the Commons, and this can only be effected by an extension of the franchise. And this, in cities, can only be done by including the lodger. We are glad to notice that an association of working men has just been formed, comprising amongst its members a large number of the representative and leading men of the London trades and friendly societies, and other working class organisations, with the immediate object of bringing the united influence of the working men of London to bear upon the Government for the purpose of obtaining the insertion of a clause in the forthcoming Reform Bill, conferring the franchise upon all adult male lodgers paying a certain rental. The first meeting has been held, and a deputation formed to confer with Earl Russell on the matter—to point out that the adoption of a £6 borough franchise, if confined to householders, will not give a single vote to the unenfranchised working men, which, if rent is to be a consideration, can only be obtained by taking lodger's rent into consideration. An extension of the hours of polling in the metropolitan boroughs is to be suggested, so as to enable working men to give their votes after working hours, and thus enable them to vote without losing perhaps half a day's work—thousands being employed miles away from their residences. Very good instances have been brought forward, in which it is shown that many "landlords" pay less than their lodgers. Thus, for instance, we know a mechanic who has four rooms in a six-roomed house—the landlord "standing" at 4s., the "lodger" at 6s. 6d.! This has been paid by both for years. Now, the mechanic is an excellent fellow, shrewd and intelligent withal. His landlord is a plodding individual, who can neither read nor write! There are thousands of such cases; we daresay every one of our metropolitan readers knows at least one such case. We lately heard of a case in which a lodger pays exactly the same as the householder (who, by the way, is a land*lady*)—so that there is no vote for this one house. Probably some of our readers are acquainted with similar instances. Now this lodger is quite capable of exercising the privilege—and it is a privilege—of voting for a "fit and proper representative." But we think there must be some restriction in conferring the privilege, which space will not allow us to descant upon. The "vote" is the right of every man who has a stake in the country, and in its well-being—but not of every man. There are certain qualifications which go to make up the man which are required in voting more, perhaps, than in most other things. And were a fair standard struck as regards these qualifications, we are afraid some of the present holders of the right would go to the wall, while many would be kicked out of the precincts of a polling booth.

We admire the step taken respecting the lodger franchise, and wish it every success. We are sure Earl Russell and Mr. Gladstone will do their utmost to favour the *bonâ fide* working man in the plans now in gestation, and that whatever may be brought forward this session, it will be a step in the right direction. We have had our short say: we are in favour of an extension of the franchise, of a weeding of the House of Commons, a little less political magic-lanterning, and a great reduction in our yearly bills. The last will be accomplished by the first—not till then.

TRUE CO-OPERATION.

The "partnership of industry" we have long looked upon as true co-operation—the workman in his position, the employer in his, and yet the workman not only receiving fair wages for a fair day's work, but participating to some extent in the profits he assists in making for his employer. Nor are we alone in this opinion by a long number; and we are happy to see it gaining ground. We believe that, for one, the talented principal of the Britannia Works, Manchester, Mr. William Muir, has long been convinced that this would, in the end, be the great bond to unite masters and men, and there are in his acquaintance those who hold the same opinions, and are ready to act upon them. In the proper Section at the last meeting of the British Association, Mr. Muir gave vent to his opinions on "partnerships of industry"—they have now been carried into effect by the Messrs. Greening and Co. (Limited), manufacturers of iron and wire fences, &c., Manchester. At the last meeting of the directors, held on Feb. 12, it was unanimously resolved that, in order to stimulate the zeal, fidelity, and good will of clerks, foremen, and workpeople, and to enable them to

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acquire a substantial interest in the prosperity of the firm, the directors undertake to recommend and support, at the first ordinary meeting of shareholders, the adoption of the following special arrangements:—1, Whenever the nett profits in any one year exceed 7½ per cent. upon the gross paid-up capital of the company, then for every additional 2½ per cent. dividend or bonus paid to the shareholders upon their capital a dividend or bonus of 2½ per cent. shall be paid to every person employed by the company upon the amount of wages earned by him or her in the same half year; this participation giving no right to the workmen or others not shareholders to interfere in the conduct of the business. 2. That shares of the company at par value be issued from time to time to the workpeople, and that they be permitted to pay the calls upon same, either out of a common fund to be subscribed by them, or out of dividends and bonuses accruing to them. 3. That the foregoing resolutions be printed and circulated among the workpeople, with a cordial appeal to them to co-operate in promoting the welfare of the establishment of which they form a part.

What the effect of this will be we think there can be little doubt: for surely now, if ever, "7½ per cent. and peace have kissed each other." If the limited liability system is to remain and be the way of conducting business in the land, most certainly this substantial recognition will materially enhance the value of the shares. Suppose a man makes £100 a year under the arrangement, and 12½ per cent. is the dividend, the man receives what will pay half a year's rent! That is just what the thing comes to. Or, it is the education of two or three children. There are a hundred ways of looking at the matter—these are but two of them. Away from the money, look at the provocative to good fellowship. And it will *not* do away with Unions, but it will very much improve their constitution, and so enhance their value to the workmen members. Our readers can follow out the subject to the end. We say the example is highly worthy of imitation—by all employers of labour; for this will help them to retain good men; as it certainly will go a good way to make good masters. For: It is more blessed to give than to receive.

SAFES AND THEIR CHARACTER.

It is not by any means a modern "adage" that "what one man can make another can unmake"—opportunity being given, with appliances. And we apprehend this holds good as well of safes as of garments. It may be possible to make a safe of a quality to resist the best tools of the best burglars, but we apprehend the day when that will be accomplished is yet far off. The best extra guard to a safe containing property valued at thousands of pounds sterling is a watchman, and we believe that has been well proven long ago. Many of the safes now in the market have, and deservedly, a very high character as fire and thief proof—up to a certain point; beyond that, we fancy, it is scarcely possible to go. The best burglar in the world, perhaps, is a very exceptional trial for a safe, and we cannot see that any manufacturer's character is at all affected when his goods have given way under the hands of such a wondrously clever scoundrel as the convict Caseley. He is a man, by the way, whom we would not believe on oath, and the evidence given by him at the recent trial we take to be—simply a story which may be true, or a "rollicking lie." True, he opened the safe, but—he had a long time to do it in; and we believe it took him the best part of his time to do it, and that he would have been glad to effect his object in less time, even by the use of what he was pleased to facetiously term "unlawful tools." That is our belief, and we are glad to see others are coming round to it. We are not acquainted with the manufacturer of the safe in which Walker, the jeweller, stored his treasures, nor have we the pleasure of the acquaintance of any safe maker; and it may be granted to us that we are not prejudiced in favour of any. If any one has taken the trouble to read the evidence given at the late trial of "Walker *v.* Milner and another," he will find that the trial the safe was put to was a very hard one—especially after a couple of safes had been carefully experimented upon ere the final *coup* by the burglar Caseley.

Some journals have paraded the burglar's opinions of other, and rival safes, in their columns as so much really damnatory evidence; this, perhaps, their advertisers will not admire, and we shall not think it strange should we hear that they do not. It is, most decidedly, unfair to give such prominence to a burglar's braggadocio estimate of people's goods; and would almost tempt some advertisers to get and print the certificate of professional burglars as to the quality of their goods—much as certain nostrum vendors publish the "testimonials" of mysterious noblemen and gentlemen as to the wonderful efficacy of the said nostrums.

We throw out the hint; and really, if we are to be favoured with such remarks as go to elevate burglary into a profession, take the raw edge off wrong doing, and familiarise youth to hear such crimes laughed at—why, it will pay, commercially, to get the *entrée* to Pentonville and Millbank Prisons, and tout for "certificates" among the "intelligent, sharp-witted, and repentant" blackguards therein confined.

We forget the result of an experiment made some years since—the testing of the splendid tools used by burglars; with the object of getting at the quality of the material so as to produce a better in safes. There may be something done with this idea, though we doubt it—the surface exposed is so very different as is the manipulation in manufacture.

We do not believe that any safe has really been lowered in character through the braggadocio of Caseley and the ill-judged comments of certain commentators. It will, we sincerely trust, be many years ere we have the scoundrel adrift in society again; and it will be long ere his equal for perseverance and readiness in emergencies is found trying his hand on such safes as Mr. Walker's; but in the meantime it behoves safemakers to carry on experiments and endeavour to perfect their wares—to attain, if it be possible, to that perfection which defies the devouring element, and blunts and breaks the tools of the most skilful among burglars

THE ART OF COINING.

II.

When the metal has been reduced to a fluid state, which occurs about forty or forty-five minutes after it has been deposited in the crucible, the moulds are advanced towards the furnaces, and preparations made for lifting a loaded crucible from its bed. Those preparations are simple, and by means of a lever and a pair of hanging tongs, which clasp the crucible just below its largest circumference, the latter is easily raised and placed upon the iron table surrounding the furnaces. There it rests for a moment, and until a workman has passed around it an iron loop with a handle of convenient length. Another workman attaches a line and hook, pendant from the roof to the loop, and thus assists the pourer in supporting the weight of the crucible. Steadily the vessel is conveyed to the mouth of the first mould, and the metal falls in a cream-like stream into it. Very soon the mould is full, and a bar cast. Mould after mould is thus charged until the crucible is empty; then it is returned to the furnace, and recharged with ingots, whilst another is taken from its seat, and conveyed to the moulds in the manner described.

When one set of moulds has been filled, the carriage in which they are supported is pushed along the rails towards a cold-water cistern. The tie bars are unscrewed next, and as the moulds are formed in halves, they are readily separated, and the castings within them are caught dexterously by workmen who plunge them at once, hissing and sputtering, into a cold bath. Half sovereign bars are produced in a similar manner, the moulds being slightly smaller.

The quenched bars are now withdrawn from the water and placed side by side on a table for trimming. This is performed by a workman who however, he purpose a cold chisel. As the chips, are of more value than those found on the floor of an engineer's shop, they are taken especial care of, and will presently be re-melted. Another assaying has to follow, and the bars are distinctively stamped with numbers and letters, so as to identify them with the crucibles from which they came, and the day on which they were cast. This done, cuttings are taken from them for chemical analysis as to their rate of purity.

In the melting of silver very similar arrangements are carried out, the only difference consisting in the size of the appliances, and the materials of which some of them are composed. Instead of plumbago crucibles of small dimensions, wrought-iron pots, fifteen inches in depth, and twelve inches in diameter, are employed for the fusing of this metal, the furnaces, of course, being much larger. A swing-crane is used for lifting out the charged pots, and a "cradle," moved by means of toothed gearing and crank handles, receives them before the metal is poured into the moulds. In fact, machinery is made to do in this case what is effected by hand in regard to gold; the treatment of bronze in the melting department, on the contrary, resembles that of the last-named material.

Returning now to the gold-melting room, we find that an exact balance is being taken of all the precious metal within it, and that the result is compared with what was given out in the form of ingots and alloy at the commencement of the day's meltings. Some allowance has necessarily to be made for the volatilization of alloy in the process of fusion, but the amount of that allowance being known, and constant, no chance of an unaccountable difference in weight can occur without detection.

Bars of gold and silver for coinage are of varying sizes, so as to suit the denominations of money to be produced from. They are rectangular in form, an end section giving the accompanying figure:—

When rolled down, as they eventually will be, to the thickness of the coin for which they are intended, each bar will, as a rule, be just wide enough for two rows of blanks or planchets, to be punched side by side from them. It may not be improper to furnish here a table of the dimensions and weight of bars of all kinds as at present cast, for the purpose of coinage at the Mint. It is as follows:—

Name of coin	Length of bar inches	Width inches	Thickness inches	Weight (Troy oz.)
Gold:—				
Sov.	24	1·37	1·00	320
Half sov.	24	1·12	1·00	250
Silver:—				
Florin	21	2·12	1·00	220
Shilling	21	1·43	1·00	150
Sixpence	21	1·12	1·00	120
Threepence	21	0·87	1·00	96
Bronze:—				
Pence	24	2·50	0·37	100
Halfpence	24	3·00	0·37	117
Farthings	24	3·00	0·37	117

The particulars relating to crown, half-crown, and fourpenny piece bars are omitted because none of those denominations of money have been struck for many years at Tower Hill, and it is very probable that the whole of the three are doomed to be expunged from the coinage of Great Britain. Every year, indeed, a considerable number of these coins pass into the melting-pots and are converted into one or other of the kinds of money referred to in the table just given. Their total extinction is, therefore, apparently a question of time. The silver crown is certainly an unwieldy piece, more resembling a medal than a coin. It is doubtful whether a gold crown might not well become its successor.

It is time, however, that we attended once more to our sovereign bars. When the assayers have reported upon these, and given assurance that they are only slightly *worse* than standard, which they must be made, as a subsequent refining operation will rob them of some alloy, they are returned to the central office of receipt and delivery. There they are weighed with great exactitude, and handed over to the care of an officer of the Coining Department for transmission to the Great Rolling Room.

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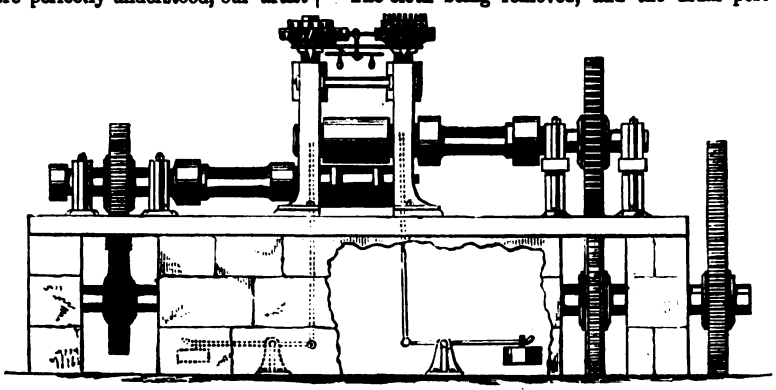
The machinery of this place comprises six pairs of rolls supported in frames more or less massive and driven by spur gearing of great strength. Tunnels or trenches have been formed beneath the mills and through them (the trenches) are carried ponderous shafts connected with the propelling power, a 40 horse-power engine. Two sets of annealing ovens, a large pair of cutting shears, and two pairs of discs of steel, running edge to edge and capable of cutting thin strips of metal with great rapidity, make up the principal appliances of the rolling room.

Beside the largest mill, the rolls of which are of chilled cast-iron truly turned and excessively bright, a batch of bars are placed. The upper roll of this laminating apparatus is balanced by levers and counterpoise weights concealed in the tunnel below. Two screws passing through the frames of the mill press upon the bearings of the upper roll from above. The screws are capped with worm wheels into which are geared "worms" of wrought iron mounted on a cross spindle and moveable by crank handles. The workman by moving this latter has complete control over the upper roll and may regulate its distance from the lower one to the greatest nicety; an index at the top of the mill indeed records that distance exactly at any moment. The coupling on the driving shaft of the upper roll is loosely fitted and accommodates itself to all changes. In order to make this arrangement more perfectly understood, our artist has supplied an illustration of the whole contrivance, which is known as the rough-bar or breaking down mill, and used for laminating both gold and silver. The side wall of the tunnel has been partially removed in order that the counterpoises, &c., may be seen.



Let it now be supposed that the shafts and gearing are in motion, and that the rolls have been adjusted for the first pinch. The distance between them will be rather less than the thickness of the bars. One by one the latter are presented to the rolls until the whole batch are carried through; they are thus elongated somewhat and reduced in thickness. Another adjustment of the mill, and another series of pinchings; another, and another; and now the twenty-four inch bars with which we began are six feet in length, and only a quarter of an inch in thickness. They have become hardened, too, and the rolls take less and less effect upon them. The shears are put into requisition, and very soon the strips of metal are cut into short lengths for the purpose of annealing. In order to accomplish this latter process the ovens near at hand are used. The sheared strips are placed in copper receivers made air-tight, or nearly so, by caps and fire clay, and then run on small iron carriages into the ovens. A short hour's baking is sufficient to cause the expansion of the crushed fibres of the metal, and then it is withdrawn to make room for more. The annealing is completed by plunging the receivers, gold and all, into cold water. The strips are now pliable and ductile, and are carried to smaller mills for further reduction in thickness and further extension in length. This is a mere repetition of what has been done in the way of rolling already, only on a lesser scale and with greater exactitude. It is termed fine rolling, and the last step in this direction, taken at the Gauging Mill, leaves the golden bars mere ribbons of metal, very little thicker than the coins of which they are the progenitors, and of nearly uniform substance. Careful gauging and weighing at this stage indicate when the precise effect required is produced. All scraps and sweepings of metal here, as everywhere throughout the Mine, are jealously sought after, and a balance struck, before the fillets of gold are sent on towards their final destination.

(To be Continued.)

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

THIRTEENTH ANNIVERSARY DINNER.

ON Saturday last, the 17th inst., the Large Hall of the Freemasons' Tavern, Lincoln's-inn-fields, was crowded with a highly respectable gathering of Foremen Engineers and their friends, met to partake together the thirteenth anniversary dinner of their Association. About 250 sat down to a plentiful and excellent repast.

Among those present were—John R. Ravenhill, Esq., C.E., (Chairman), James Stabler, Esq. (Deputy-Chairman), Rev. Daniel Greatorex, Incumbent of St. Paul's, E. (Chaplain), J. Newton, Esq. (President of the Association), T. Sanson, Esq. (Hon. Sec., Vice-President of the Association), J. D'A. Samuda, Esq., M.P., E. J. Reed, Esq. (Chief Constructor of the Navy), Commander J. W. Reed, R.N., Captain Clarke, R.E., Major Davidson, E. Humphreys, Esq., John Penn, jun., Esq., &c., &c.

Very happy arrangements were made at the lower end of the hall, for the enlivening of the evening by vocal and instrumental harmony.

The cloth being removed, and the usual post-prandial chant rendered in effective manner by the vocalists present, the CHAIRMAN gave in due order, the loyal toasts, and the patriotic, with which latter were coupled the names of Captain Clarke, R.E., for the Army, Commander J. W. Reed, R.N., for the Navy, and Lieut. D. Campbell—of the Atlas Iron and Steel Works (John Brown and Co.), Sheffield—for the Volunteers.

Captain CLARKE said that the common interests of all men in this country ever made the toast of "The Army" acceptable; but to those gentlemen present at that meeting the toast had a still closer meaning—for they, by their skill, knowledge, and enterprise, had largely supplemented all that the Army had done, by teaching them how to use aright the means and skill that God had given them.—J. W. REED, R.N., referred to the period, not long since, when the Engineering branch of the Navy was thought little of, and held but as of light importance. Now Naval Engineers were represented in every part of the world: they had risen from a position of neglect to that of commissioned officers. They were to be found on men of war, in every steam ship, and were of the greatest importance to this country. One remark he would wish to lay great stress on—Foremen Engineers, and men in their position, had the training of boys for the Royal Navy, a most responsible duty, and therefore he was very glad to see them uniting as at present for mutual benefit, in body and in mind, as it augured well for the right rendering of the important duties to which he had referred. (Hear, hear.) The services had become full of engineers, and it was of importance that every effort should be encouraged that displayed the presence of self-reliance, and the desire for social and professional elevation. (Hear, hear, and cheers.) — Lieut. CAMPBELL had not much to say, after he had returned thanks. He simply trusted that when our soldiers and sailors went forward to fight the battles of their country—that if the volunteers did not join them there, they would try to keep peace at home. Whilst the Engineers, and the Volunteers of England were duly encouraged and patronised, he had little fear for the peace and security of our beloved land. (Hear, hear.)

Preceded by a grand flourish by the toastmaster, the CHAIRMAN next gave "The House of Commons," which brought J. D'A. SAMUDA, Esq., the newly elected member, to his legs, amid the most deafening cheering. He was very proud and happy to have received at their hands an ovation of such an unusual description, more especially as that was the first opportunity he had had of addressing any public assembly since his return to Parliament. He returned thanks for the way in which they had received mention of "The Commons," because he knew that that house had been ever composed of gentlemen who had sought the good of their country;—of men of untiring energy, diligence and ability. That house had for the last 200 years never ceased in its exertions to preserve the liberties and to increase the happiness of the people of this realm (Hear, hear). And thus it was that while all Europe had been in days past shaken to its centre by revolution and change, England had remained uniformly tranquil and prosperous. The especial interest he (Mr. D'A. Samuda) took in the welfare of their Association might perhaps apologise for him, if he ventured to give a word or two of advice with regard to its continued good management. First, he would intimate for their encouragement, that in almost all cases, even where the largest firms were called to recollection, the beginning of those firms was very small,—that they had risen from the ranks, so to speak, of energy and skill, irrespective of capital or position as necessary adjuncts. (Hear, hear, and loud cheers.) No amount of capital employed in the engineer's profession would give success without the necessary knowledge and skill to use that capital aright. (Hear, hear.) Energy and ability had been the distinguishing characteristics of all great engineers, and they were alone the real elements of success. Therefore, those present might hope, by pursuing a like course of conduct, to achieve similar results. The speaker then made some remarks having undoubted reference to the tendency of engineers, or any other trades, to follow their own pet leaders, even unto "strikes," and evidently hoped (in his fears) that such might not be the case with the Association then under notice. He expressed the entire approbation of the heads of firms with which he was acquainted regarding their Society, as far as it had at present progressed, and wished for it much future good.

On the return of Mr. Samuda to his accustomed reticence, Mr. D. WALKER, the Secretary, read the following report:—

"Mr. Chairman and Gentlemen,—In producing our Thirteenth Annual Report, your Committee have much pleasure in recording continued progress in the various departments of the Association, and the interest of its proceedings.

"During the past year our numbers have greatly increased, 23 ordinary members having been elected, many of them holding positions of considerable importance in our trade.

"Twenty-two honorary members have been enrolled, chiefly gentlemen of high position in the walks of science and of literature, our list now including the chief employers of the metropolis; two ordinary members have withdrawn, three have been removed by death, thus leaving an effective list of 87 ordinary members, and 50 honorary members, making a total of 137.

"Our ordinary funds steadily increase, although this year the claims upon them have been unusually heavy.

"In financial matters the following may prove interesting:—Income, hon. members (ten donations), £41 10s.; annual ditto, £10 10s.; ordinary members' subscriptions, £116 2s. 6d.; subscriptions to library, £18 4s. 6d.; entrance fees, £18 18s.; interest on stock, £10 5s. 9d.; total, £215 10s. 9d. Expenditure, £183 4s. 0½d.; making the increase of funds, £32 6s. 8½d., which added to the stock

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of last year, £396 10s. 5d., makes a total of £428 17s. 1½d.

"These figures show a very satisfactory state of things; for in a commercial country the firm financial position of an undertaking is held the great test of a sound and healthy constitution.

"Additions have been made to the library of various standard works, as well as the scientific periodicals of the day.

"The Committee have to acknowledge donations of books from Mr. Bennett Woodcroft, Mr. Mallett, and from Captain M'Gregor, those of the two latter gentlemen being their own works.

"The books of the library have been re-arranged, and a catalogue prepared which will shortly be in the hands of the members, so rendering them more available for reference.

"The Superannuation Fund for the aid of aged and infirm members of the Association is now substantially in existence; the sum proposed by Mr. Grissell as a nucleus has been realised, and £541 15s. invested in purchase of stock in the Three-per-Cent. Consols, to the amount of £600,"&c.

The CHAIRMAN had at length a very pleasing duty to perform, and that was to give the toast of the evening—"Prosperity to the London Association of Foremen Engineers." Fourteen years ago 16 members paid down each 5s. as an earnest of their sincerity and determination to found that Society, and he thought those men worthy of all honour. After commenting on the encouraging nature of the Report just read, and the firm hold the Association had now over the great mass of the trade, the Chairman gave way for the response of the President.

Mr. J. NEWTON rose, and made the burden of his remarks his belief that the Association under notice could not, according to the very rules of its constitution, interfere in any merely trade matters, and would not do so if they could, because they knew (and he, their President knew) that it was essential to the welfare of their Society that the bond of union should be complete between the employer and employed. The gentlemen on his right and left would therefore have nothing to doubt or fear on that behalf. He had long been their President, and knew well the feelings of the members, and he was positive that nothing but the social and professional elevation of the members was contemplated or sought. (Hear, hear.) Their Association was a most important one to both masters and men; for the papers read at their meetings, and the discussions that occurred thereon, could not but render each attendant at them a better and abler engineer to all intents and purposes by each visit, to the advantage of his employer and himself. (Hear, hear.) Employers might be assured that the Association would never swerve from its own original purpose, and that their interests, as well as those of their men, were bound up in its prosperity. (Mr. Newton sat down amid loud and long continued cheering.)

EDWARD HUMPHREYS, Esq., feared Mr. Newton might mislead his hearers a little, if they took his estimate of the professional state and talent of English engineers unqualifiedly. He had lately been on the Continent, and he had there discovered that John Bull was not such a clever fellow, after all, as it was thought he was. (Laughter.) English engineers would have to do all they could henceforth only to keep their position with regard to the Continent. (Hear, hear.) Much of the engineering work that used to be done here, was now executed abroad.

JAMES SIMPSON, Esq., and DAVID THOMPSON, Esq., also spoke to the meeting.

On the toast of "Iron Shipbuilding," J. D'A. SAMUDA, Esq., M.P., supported Mr. Humphreys in his remarks relative to the rapid progress of Continental engineering. He believed, from late visits he had made to the Continent, that the Continentals were making far more rapid strides than we were in naval and general engineering: they were producing works of the greatest magnitude, so that although at present we might be ahead, it behoved us to use our greatest energy to keep our engineering, and so our high political position among the nations of the world.

E. J. REED, Esq. (Chief Constructor to the Navy), also expressed similar sentiments, and referred to the want of thought and skill occasionally noticed among English engineers in reference to iron shipbuilding, in the matter of lightness, strength, and displacement, thereby showing the room for improvement, and the probable advantages of such a Society as the one under notice.

Many other toasts followed (such as the Press, Donors, Officers, &c., Founders, and the Ladies), and many smart and happy things were said, but our space forbids their reproduction. Between the speeches the audience were charmed with some very excellent vocal and instrumental performances, the solo singing being exceedingly good and creditable to all concerned. Great praise is due to Mr. Thomas Sanson, the hon. secretary of the dinner, and to all the officials who had any part or lot in the matter, for the admirable arrangements that existed throughout, and for the consequent harmony and peace of the proceedings. The gathering broke up in excellent time and humour.

A WORKMAN'S FESTIVAL.

For some time past the subject of local Industrial Exhibitions has occupied considerable attention among the working population throughout the country, and there is scarcely an organ of public opinion but has taken a part in discussing how these popular demonstrations of working-class energy should or should not be managed. An effort is now being made to combine with a metropolitan and provincial exhibition a series of working-class demonstrations, and to unite as many attractive features as may be consistent with the idea of a workman's festival. The exhibition is to take place at the Agricultural-hall, Islington, in September next, and to consist of contributions exclusively from workmen in London and the provinces. For the benefit of the latter the railway companies have liberally offered to return unsold goods free, so that the expense of carriage to exhibitors will be but half the usual charge. An attractive item in the programme is the fitting up of small workshops, supplied with steam power, where mechanical operations will be carried on in the presence of the visitors, similar to that which proved so great a feature in Glasgow.

With the view of rendering some practical assistance in art (and not before it was wanted), the Lords of the Committee of Council on Education will furnish a full illustration of the instruction afforded in the Government Schools of Art throughout the United Kingdom. These will, no doubt, be the best productions of the students, and may lead many to avail themselves of institutions of the existence of which they are probably at present ignorant.

The musical arrangements are of an extensive character, but will be chiefly confined to societies supported by the working classes. In addition, lectures are to be delivered, and a flower show is to be held, while a large hall will be fitted up for the use of trade and other societies who may desire to hold meetings during the period the exhibitions remain open. There are other matters referred to in the programme, including an Art and Industrial Union, to encourage the sale of the articles exhibited; but sufficient is here stated to show the character of the undertaking. The list of patrons and guarantors is a goodly array of influential names, but the success of the scheme will depend upon working men themselves, who must now unite, act with discretion, and make a vigorous effort to succeed in any movement organised for their social or political welfare.

PUBLIC BUILDINGS.—A terrible illustration of the necessity for making the doors of all places where large assemblies are gathered to open outwards has just been afforded by the destruction, by fire, of fifty-four men in a wooden building at Cronstadt, of which the only means of egress opened inwards, so that when the imprisoned and imperilled creatures strove to escape, their own terror gathered them *en masse* against the door, and their weight kept it firmly closed.

SUBMARINE TELEGRAPHY.*

III.

SHALLOW AND DEEP SEA CABLES.

TABLE V.

SHOWING WEIGHTS OF IRON WIRE OF DIFFERENT GAUGES.

B.W.G.	lbs. per knot.
00	2066·68
0	1716·48
1	1393·92
2	1212·20
3	1048·32
4	872·80
5	748·80
6	622·08
7	529·92
8	449·28
9	368·64
10	305·82
11	241·99
12	184·32
13	144·00
14	109·44
15	86·40
16	65·66
17	50·68
18	39·16

4. *Sheathing Machines.*—These apply the wire with a constant tension, and, so as not to twist it, keeping one side always uppermost, so that if it faces the core below the cable, it will be turned away from the core at the top. To do this each bobbin holding the wire moves parallel to itself. The effect of this arrangement was experimentally shown with the india rubber tube to represent a wire. The effect of the other arrangement, in which the bobbin moves round the cable fast on a disc, as the arm of a wheel moves round the nave, or as the moon round the earth, was also shown. This arrangement twists the wire. Cables made with twisted wire are weaker and less manageable than those made with untwisted wire.

5. *Permanency of Cables.*—The wires of cables may rust or be chafed through on rocks, or be eaten through by some chemical action other than simple rusting, or they may be broken by anchors. Any motion in the water round a cable much accelerates the rusting away, and chafing depends wholly on this cause. In some bottoms, even in still water or great depths, decay does occur very rapidly, and this must be due to some other cause than simple rusting. Large wires are the natural protection to injury from the causes enumerated. Galvanising also protects the wires from simple rust. In some situations the simple unprotected wires remain wonderfully unaltered, but protection where possible should always be given. Bright and Clark's silicated bituminous compound applied over the wires affords the best protection yet known. The Persian Gulf Cable is coated with it from end to end. To ensure permanency, cables in shallow seas were now laid weighing as much as ten tons per mile with shore ends weighing nearly twenty tons to resist anchors (*vide* England-Holland Cable, Appendix). Many heavy shore ends were covered with strands of wire instead of simple wires. Mr. Siemens proposed to apply a covering of hemp outside the iron wires and to wrap this round with a zinc armour.

6. *Statistics of Cables in Shallow Seas.*—The total failure of all kinds, in shallow water, excluding cables which had no proper outer iron protection, did not amount to 100 miles. About 2,350 miles have been laid, which worked for some time, but are now abandoned. Of these 1,400 miles weighed less than one ton per mile, a weight which, for shallow seas, is now known to be absurdly insufficient; these worked for about two years upon an average. 950 miles weighed more than one ton but not more than two tons per mile. The average life of these cables was five years. 5,000 miles are now certainly at work, possibly more; they have already worked upon an average four years and a half; they include one cable which has worked for 15 years, and several 13 years old; but the average is lowered by the

* Lecture II.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, February 5.

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long Malta-Alexandria, and the Persian Gulf cables, only lately laid. Every one of these cables, except the Malta-Alexandria, not originally designed for shallow seas, weigh more than two tons per mile. The interruptions on the lighter cables are somewhat frequent. On the Malta-Alexandria they have averaged four days per 100 miles per annum. Even this is not worse than the best land-lines in India, and is ten times better than the worst land-lines in India.

7. *Maintenance and Returns from Cables in Shallow Seas.*—The average cost of maintaining cables of the Submarine and Electric Telegraph Companies has been for some years from £8 to £9 per mile, excluding the cost of total renewals, which should be provided for by a reserve fund. The expense of the Malta-Alexandria repairs is not known. This line has earned as much as £3,000 in one week, or at the rate of £117 per knot per annum. In one year the average earnings during the time it was open were at the rate of more than £90,000, or £68 per knot per annum — allowing for interruptions, the maximum earnings in one year were £64,000, or £48 per knot. The Persian Gulf cable is said to be earning at the rate of more than £100,000 per annum, or £85 per knot per annum. Neither cable has yet worked under favourable conditions; the former ends in a *cul de sac*, and the land-lines connected with the latter are so badly worked as to cause extreme delay and uncertainty. Such cables can be laid for sums varying from £300 to £400 per knot. The receipts on the Submarine Company's lines seem lately to have been at the rate of about £85 per knot of cable, or £26 per knot of insulated wire.

8. *Deep-Sea Cables.*—Cables laid in less than 1,000 fathoms would now hardly be considered as deep-sea cables, but formerly a depth of 300 or 400 fathoms was thought sufficient to entitle a cable to be put in this class, and the old classification has been adhered to in preparing the statistics of shallow-sea cables. A cable to be laid in a deep sea must, of course, be strong, both absolutely and relatively to its weight in water; it must be light, or the great lengths required cannot be conveniently carried; it must not be liable to stretch, and it must coil well and be paid out easily. At first, light specimens of the form already described as used for shallow seas were generally employed. The Red Sea cable is a fair sample. The first Atlantic cable is very similar, but the simple outer wires were replaced by strands of still smaller wires. The examination of Table IV. will show how far these cables met the above requirements. They could support from 4,000 fathoms to 5,000 fathoms of themselves hanging vertically from the ship. They could be laid, and about 7,000 miles of this class were laid, in depths approaching or exceeding 2,000 fathoms, and these cables have even, for a few miles, been hauled back from these depths. They seldom broke while being laid, but they were not permanently successful. Communication generally ended within a year from the time it was established, and the outer covering was then too much rusted to allow of repairs. The causes of failure were many—bad gutta-percha joints, bad copper joints, injuries to the insulator before the cable was laid, high battery power burning small faults into big ones and eating away the copper, lightning, from which they were often unprotected. These may be instanced as known causes of failure. It is also said some cables were laid too light, and sprung asunder when the iron wires rusted. It may be conjectured that when these wires rusted the gutta-percha could not bear the cable if suspended across a hollow; these are less probable causes of failure, but it is certain that the rusting of the outside and the failure of the cable generally coincided as to time. The failure was seldom gradual; it was almost, if not always, accompanied by a total fracture, or interruption in the copper. When any of these injuries did occur, they were irremediable. The first important modification of the common form was to adopt steel wires instead of iron, reducing their number, and enveloping them in hempen strands, so as to produce a cable which externally looks like a hempen rope. Many excellent experiments were made on this form of cable (which was subsequently chosen for the second Atlantic) by Messrs. Gisborne and Forde, aided by Mr. Siemens. These experiments are given in full in Appendix 10 to the "Report of the Joint Committee on the construction of Submarine Cables," published by the Government in 1861. The great strength, both absolute and relative, of this form may be seen from Table IV., showing that these hemp and steel cables will support 11,000 fathoms of themselves hanging vertically in water. The mass of steel required to cover the core is diminished by the use of hemp, but as hemp is no lighter than water, it does not buoy up the wire. A steel wire simply wrapped up in hemp weighs much the same in water as a bare wire, and therefore wires, whether simply wrapped in hemp or bare, will support equal lengths of themselves in water, but the hemp may be so applied as to add all its strength to that of the steel, although the extensibility of the two materials is different. To do this the hemp must be spun round the steel with a definite lay, to be ascertained in each case by experiment.

CREOSOTING RAILWAY SLEEPERS.

Mr. Bethell's process of creosoting railway sleepers has been largely adopted in Belgium. In the spring of 1865 a very careful examination was made by the authorities of all the creosoted sleepers, and they found that all these sleepers (although some of them had been in use nineteen years) were perfectly sound and fresh, and in consequence the Belgian Government decided to have all their sleepers creosoted in future. The annual Government report on the Belgian State Railways for 1864, states that "the administration, looking to the result of past years' experience, continues to confine itself to oak sleepers and creosoted sleepers for making or relaying its lines, as the superiority of Bethell's system over all others appears to be an established fact. Out of the 153,753 new sleepers put down in 1864, 128,165 were creosoted, and only 25,588 were unprepared oak." Mr. G. Alby, C.E., in a report to the Sardinian Government on creosoting timber, said:—"Creosote is the only antiseptic which has the property of augmenting the density of wood, and thence its resistance to mechanical actions. A fir sleeper of ordinary size has a volume of 0·70 M.C., and weighs 40 K. After its injection with creosote its weight is 65 K, and it has acquired a density equal to that of oak."

ON TIMBER SUITABLE FOR BUILDING PURPOSES.

II.

The last of the British-grown hard woods to be mentioned, although seldom used for the purpose, but which may be found useful under some circumstances in house carpentry, is elm. It has the property of not splitting, and, when mortised, biting a tenon inserted into it tightly; but it is extremely difficult to work. It, however, makes a better kinghead in a composite roof-truss than any other kind of timber, but is inferior for this purpose to cast iron, and can only be recommended for that use when few such members for roofs of a building may be needed. Any other of the British-grown hard woods it is unnecessary to speak of, as all of them, on account of their liability to the attack of insects, rapidly deteriorate in strength, and fall into a state of decay. Of the timber of the coniferæ of domestic growth, the larch and the *Pinus sylvestris*, grown in the Scottish islands, are the only kinds suitable for the use of the house carpenter; the former-mentioned for the purposes already spoken of, and the latter mentioned for inferior work in general carpentry. It may be mentioned to condemn the practice as the most egregious folly, of proprietors of estates using home-grown timber, because it happens to be on their estates, in the erection of buildings for agricultural purposes, when the cost of sawing and preparing any such stuffs brings the price of it to much more than Baltic deals, in every respect infinitely superior to any home-grown timber, except such as will always command a much higher price than any ready-sawed foreign timber can be purchased for. Besides oak of British growth, previously treated of, oak is imported from the Continent of Europe and from America. The Turkey oak, *Quercus cerris*; the Holm oak, *Quercus ilex*; wainscot from Riga and Dantzig, and the cork tree oak from the Mediterranean, are from the former-mentioned part of the world; whilst the American oak, *Quercus alba*, and the Canadian oak, *Quercus rubra*, are American varieties. All these foreign varieties of oak are, however, inferior to English oak in durability. Riga wainscot, imported in quartered logs, with the bark on the outside surface of the quartered tree, and sold by the quantity of 18 feet cubic measure, is frequently very beautifully mottled, and valued by cabinet makers for the manufacture of furniture, and by joiners for doors, pannelling, window sashes and cases, floors and stairs for the best fitted houses. Mahogany is still more useful for the purposes mentioned than wainscot. Besides the remarks I have just had the honour to submit to the present meeting of our association, I would wish to draw attention to a matter of considerable importance in the use of timber in domestic architecture, and that is the preparation or seasoning of timber, with a view to prevention of its decay. The seasoning of timber is, no doubt, best and most perfectly attained by air drying, that is, in being subjected to a current of atmospheric air in the shade, and protected from rain. This, however, requires great length of time thoroughly to effect, and has led to several expedients to be had recourse to, to obtain the same results in a much less space of time; but although effectual to a great extent for the immediate purpose in view, all the artificial processes to which I allude are accompanied by some objectionable result so as greatly to deteriorate from their merits, and thereby to render them in a greater or less degree failures. I shall now request the further indulgence of your attention to a few brief remarks on the processes of artificial seasoning of timber which have been most frequently adopted with a view to increasing its durability. The first of the means alluded to, rendering timber more durable, to which I will refer, is placing it in a stream of water saturated with lime for eight or ten days. This process has certainly the effect of rendering timber more durable, and less liable to the attack of worms; but it, however, becomes so hard, after being dried, as to be very difficult to be worked; and, therefore, the process should be applied after the timber has been sawn into the scantlings in which it has to be used. This process, it may be remarked, is to be recommended in cases where home grown timber—particularly fir—is used for building purposes. By the process of creosoting—that is, of timber after being heated being painted over or steeped in Stockholm tar, oil of tar, or creosote, all of which articles are the same, but in different degrees of purity—the timber is rendered more durable and less liable to the attack of worms; but by this process it is rendered very inflammable and liable to accident from fire; in addition to which the disagreeable odour from timber so treated renders it objectionable for being used in the building of dwelling houses. Kyan's process for prevention of decay, which consists in impregnating the timber with corrosive sublimate, renders wood to which it is applied brittle. Timber, when steeped in a strong solution of alum, soda, and in some other solutions of mineral salts, is free from the attack of insects, and rendered in a great degree fireproof; but the process greatly impairs its strength. Whatever may be the direct advantage obtained by the processes of which I have just spoken, when accompanied by some objectionable property or other, they cannot be said to be worthy of adoption in preference to, or to supersede, the airdrying of timber to season it for building purposes, except when the saving of time may be an important object. Before dismissing the present topic, there is an important fact in relation thereto yet remaining to be noticed, and which appears to be but little understood, or, at least, seldom attended to. The fact to which I allude is, that when timber used as posts inserted in the ground is placed in the inverted position to that in which

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it stood when growing it is very much more durable than if placed in its natural or growing position. This is easily accounted for in the valves of the sap vessels of the growing timber opening upwards; but when the position is inverted, the valves of the sap vessels become reversed in their action; and, therefore, when timber is used as posts inserted in the ground, the valves being so reversed prevent the ascent of moisture from the soil in the wood. A safeguard against the decay of posts, which should never be omitted to be taken, is charring their lower ends to the distance of several inches above the ground in which they are to be inserted. I may also remark that charring the lower ends of posts is to be preferred to the use of creosote.

REVIEWS.

Guide to the British Arsenal. By HENRY KNELL. Woolwich. Kent and Co., Paternoster Row. Price One Shilling.

The author of this little *brochure*—which is infinitely more than it pretends to be—is a working man; being, we believe, employed in the Great Arsenal at Woolwich. We have perused the book with great pleasure, and can recommend it to all who care to know anything about the Arsenal and its interesting surroundings. Great have been the changes in Woolwich since the days of its fishing village or grubstate—when as the Manor of Haimo, the Sheriff of Kent, it was valued in Domesday Book at £3—up to its present, shall we dare to say full-fledged condition? Yes, the value was set down at £3, and on the Sheriff's estate were four boarders who paid a rent of 41 pence! What some people term "accident," was the origin of the greatness of Woolwich. Says our author:—

About the year 1716, when Colonel Armstrong was Surveyor-General of the Ordnance, and George Harrison, Esq., Superintendent of the Foundry, then in Moorfields, it was determined to re-cast the unserviceable cannons which had been taken from the French by the Duke of Marlborough, and which had hitherto been placed before the Foundry, and the adjacent Artillery Ground. This becoming generally known from the guns being exposed for some time to the public, excited a more than common interest, consequently a great number of persons assembled to view the operation. Among whom were many of the nobility, gentry, general officers, &c., for whose reception galleries had been erected near the furnace. Early on the same day, a native of Switzerland, by the name of Andrew Schalch, who had visited several foundries on the Continent, was attracted to the place, and was allowed to minutely inspect the works then going on. Colonel Armstrong was himself present, and Schalch, from his knowledge of chemistry, apprehensive of an explosion from the latent dampness which he had observed in the mould, communicated his fears to the Colonel, and warned him to retire from the impending danger. He at once comprehended the importance of the Swiss gentleman's remarks, and at the same time interrogated him respecting his knowledge of the art, and found him perfectly conversant with all its principles. He therefore resolved to follow his advice, and quitted the foundry with his personal friends, and as many of the company as could be prevailed on to believe that danger really existed. Scarcely had they got a sufficient distance from the scene of action when the furnace was tapped, out poured the fiery torrent, and coming in contact with the humidity of the moulds, a large body of steam as a necessary consequence was generated, as was foretold by Schalch. A terrific explosion was the result, which instantly threw the whole neighbourhood into the greatest consternation. The liquid fire was scattered about in all directions. The roof of the building was blown off, and the galleries fell with a tremendous crash; many perished in the ruins, others were dreadfully scalded, and many persons had their limbs broken and otherwise mutilated. A few days afterwards an advertisement appeared in the public journals, stating, in substance, that if the young foreigner, who had been in conversation with Colonel Armstrong on the day of the accident at the foundry in Moorfields, and who had suggested the probability of an explosion, would call on the Colonel at his official residence in the tower, the interview might conduce to his advantage. Mr. Schalch was informed of this advertisement by an acquaintance, and was not long in obeying this summons, but directly waited on the above gentleman, who after some preliminary conversation, informed him that the Board of Ordnance had in contemplation to erect a new foundry at a distance from the Metropolis, and that he was authorized through the representation he had made to the Government, to offer him a commission, to select an eligible spot, situated within twelve miles of London, for the erection of a suitable building for a Gun Factory, having reference to the extensive nature of works, and carriage of the heavy materials, and also to engage him as superintendent of the establishment. This proposal was cheerfully accepted by Mr. Schalch, who immediately began his search for a proper place for the construction of a new foundry, and having inspected various localities, he at length fixed on Woolwich Warren. This spot was considered in every way convenient for casting heavy guns. Here the new foundry was erected; and the first specimens of ordnance cast by Mr. Schalch were so highly approved of, that he was permanently appointed Master Foundry-man, and continued to hold that office for the period of sixty years, during which time so admirable were the arrangements made, and so extensive the knowledge displayed, that not one accident occurred, amidst all the hazardous processes in which he was engaged during the great number of years they were directed by him.

As to the "business" conducted, and got through, at Woolwich, few who have not availed themselves of a "ticket" have the slightest idea. For instance—taking the carriage department alone—the following trades are therein carried on:—Draughtsmen, timber converters, wheelers, carpenters, smiths, vicemen, brass fitters, tinmen, coppersmiths, brass founders, engine fitters, collar makers, tyre smiths, wood turners, pattern makers, grinders, painters, saddlers, harness makers, engine drivers, stokers, sawyers, work takers, timekeepers, storekeepers, and ticket distributors, besides numerous tradesmen and labourers employed at the different machines. At another time we may return to this interesting book, which is published in anticipation of the "trip" season. One has not to go far from home to be deeply interseted; there are Kew Gardens, the Crystal Palace and its treasures, and, far above a host of others—Woolwich. To all of our readers desirous of knowing all about this latter place we say, purchase this working man's book.

The Builder's and Contractor's Price Book for 1866. By G. R. BURNELL, C.E. and Architect. London: Lockwood and Co.

Considering the many fluctuations in the various markets, Mr. Burnell's efforts to strike a fair average of prices for work in all branches of the building trade, and to set them out in a manner which renders each item easy of reference, are very successful; and this is increased by the clearness of the type and general work of the printers, Messrs. Bradbury, Evans, and Co., of Whitefriars. There is an appendix to the volume, of tables, notes, and memoranda, arranged to afford detailed information commonly required in preparing estimates, &c., and this will be found of great value to the architect in this "iron age." There is a very simple "parallel of French and English scales" in that section of the appendix devoted to the various measures, which will doubtless be found very useful. Altogether the work is to be commended, as portable, simple, and yet profuse; and has proven, we believe, a great success to its enterprising publishers.

The Working Engineer's Practical Guide. By JOSEPH HOPKINSON. London: Weale, High Holborn.

It is very seldom a book comes our length concerning which something good cannot be said in its favour. We like to look to the good points in a work—leaving the flaws for more speculative reviewers. And concerning that which in this work comes strictly under its title we can speak in terms of praise. In much it is exactly what it professes to be, a practical guide to the steam-engine and boiler, giving rules and instructions for valve setting, so as to secure a full development of the motive power. The whole is illustrated by diagrams. In much of the contents there is a "power" of good sense, without any straining after "fine writing," which to the practical man must be a blessing in these days. Concerning the safety valve, the author gives the following rule to ascertain at what pressure it is weighted:—

First ascertain the length, in inches, of the fulcrum, and the length, in inches, of the lever, from its attachment to the place where the weight is hung; then ascertain the weight, in pounds, of the ball weight; multiply the length of lever by the weight of the ball weight. Then multiply the area of the valve * by the distance of the fulcrum from the attached end of the lever. Then take the product of the former, and divide by the latter. The quotient is the pressure for which the valve is weighted in pounds per square inch.

42 lbs. ball—10 in. area of valve,
60 in. lever—3 in. length of fulcrum.

2100 30

30)2100(70 lbs. per square inch.
210·

This we have extracted for the benefit of our amateur friends, who frequently inquire after such. There is also a receipt for cooling necks of shafts, which may occasionally be found useful where the shafts are not of a proper length, or the bearings faulty:—16 lbs. tallow, dissolved in a vessel; 2¼ lbs. white sugar of lead. When the tallow is melted, but not boiling, put in the sugar of lead, and let it be dissolved, Then put in 3 lbs. of black antimony. Keep stirring the whole mass till cold Lack of space compels us to stay further notice this week of Mr. Hopkinson's book; but we will return to it at an early date.

* The area may be found in the book on referring to the tables in the appendix.

Photography.

We (*Photographic News*) have a very simple and curious experiment to describe in the photographic reproduction of natural colours; but as we have succeeded in the production of these colours only once, we mention the circumstance rather as suggesting a path for experiment than as establishing at present any theory or process.

We should premise that in almost every instance in which the actual production of various colours has been secured, the sensitive surface employed has been the violet sub-chloride of silver, a substance of which but little is known. In the experiments of MM. Becquerel and Niepce, it was obtained by complicated and troublesome means on a plate of silver. In M. Poitevin's recent experiment it is applied to a sheet of paper, but the details of its preparation are not published. As the action of light on white chloride of silver is to liberate chlorine, it appears probable that at a certain stage, whatever may be the final result, about which some dispute exists, one equivalent of chlorine is removed, and sub-chloride of silver is formed. It occurred to us, therefore, that in the experiments for the production of photographs in natural colours, our collodio-chloride of silver presented an agent for experiment more convenient than any other we knew. In order to test it we tried one or two hasty experiments, which we shall describe.

We first coated a plate of opal glass with an old sample of collodio-chloride of silver, containing citric acid, and then thoroughly washed it to remove free nitrate of silver and free acid. This plate, after drying and exposing to prolonged sunshine, scarcely darkened at all, not passing in a couple of days beyond a pale lavender; and when further exposed under coloured glass, became a trace darker in the unprotected portions. Beyond this no change was observed.

We also coated a plate of opal glass with a sample of collodio-chloride which had been made more than twelve months, and having accidentally been placed in the light for a time, had become altogether of a deep lavender tint. The plate, coated with this, and exposed under coloured glass, exhibited no results worthy of remark. The film showed, however, that by long contact with free nitrate of silver the pyroxyline had undergone decomposition.

The third experiment, however, gave us very striking results. In this instance we prepared a fresh sample of collodio-chloride of silver, to one ounce of which about two grains of chloride of strontium and five grains of nitrate of silver were added; the object being to form a collodio-chloride with the slightest possible excess of nitrate of silver. A plate of opal glass was coated with this, dried before a fire, and exposed to diffused daylight until it assumed a deep lavender grey tint or slate colour. Several pieces of coloured glass were then placed on the coloured surface, and the whole placed in sunlight for several hours. The coloured glasses consisted of a piece of deep ruby glass, a piece of bright orange red, and, in the absence of other colours—the experiment having been undertaken without premeditation or preparation—a piece of white patent plate, on one end of which was poured a concentrated solution of aniline red, and on the other end a concentrated solution of aniline green, a space of clear glass remaining between the two. Various spaces of the film of violet or grey subchloride remained uncovered, and, without any other glass

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over the pieces of coloured glass, the whole was placed in strong sunlight, as we have said, and left in the open air. The exact time of exposure to sunlight we cannot state, as, having exposed them about mid-day, we were subsequently called away, and found them at mid-night, when we returned, on our study table, having been taken in at dusk by one of our household. On removing the coloured glasses and examining the film by gaslight, we were surprised and delighted to find vivid indications of each colour in its true relation. Carefully placing it away in the dark, we examined it carefully by daylight next morning. Under the ruby glass the tint was of a bright claret or magenta colour; under the orange, of an orange tint, more inclining to red than the glass itself; under the white glass covered with aniline red, the tint was of an orange, but graduated into a deep purple red where the colour had, in drying, run into a pool or ridge; under the glass coated with green aniline colour a deep green, deepest where this colour had run into a pool or ridge.

But the most singular part of the case is to relate. All the portions of the film which were not covered, and which were therefore submitted to the uninterrupted action of the light, had gone on darkening in the usual way, passing from the cold grey or slate colour into a bronzed black; but the portion covered by the bare white glass, free from aniline colour, was bleached to a yellowish white; and on examining the glass carefully, we found the glass slightly tinged with yellow, as is not uncommon in the samples known as white patent plate. Here was a film of chloride of silver, which, having been submitted to the action of light until it was of deep warm grey colour, was bleached to a yellowish white by the continued action of light through a piece of yellowish white glass, whilst the portions of the same film submitted to the same light uncovered, passed on to a deep bronze black. Those portions submitted to the action of light which we should have pronounced quite non-actinic, the ruby glass perfectly cutting off, when examined in the spectroscope, all the rays above the line D, passing from the grey tint to varieties of red, and portions covered with green assuming that colour, the deepest tint being produced by the deepest colour.

In this instance none of the additional substances used by M. Poitevin—such as, bichromate of potash, sulphate of copper, or chloride of potassium—were employed. How far the experiment can be repeated, and whether other colours could also be produced, we cannot undertake to say, for uncertainty appears to have been hitherto the invariable accompaniment of this class of experiments. Our chief object in recording the result of limited experiments is to point out to others, engaged in similar research, the great advantages presented by the use of collodio-chloride of silver as a simple means of securing a layer of the violet sub-chloride, which now appears to be recognized as the common starting point.

PUNCHING WASHERS.—Washers may be very rapidly punched by using double punches and dies fixed in an ordinary punching machine. They should be placed side by side at a distance apart from centre to centre rather greater than the diameter of the washer. One of the punches should be rather longer than the other, and should be of the right diameter for forming the hole in the washer; the other should be of the diameter of the washer itself, and should have a rounded projection in the centre fitting the hole made by the first punch. The bars from which the washers are to be formed are passed into the machine from the side at which the smaller punch is fixed, and the central hole in the washer is thus first formed, and then, as the bar is passed onward, the washer itself is punched out. The projection in the centre of the second punch should be of such length that as the bar is advanced it enters into the hole made by the first punch before that punch makes a second hole, and it thus prevents the bar from being pushed forward too far, and avoids the waste of material between each washer.

HIGH-PRESSURE steam has been made use of for the distillation of mercury.

SCIENTIFIC NOTES.

CARBONIC ACID.—Sir Walter Trevelyan, writing to the *Gardeners' Journal*, starts a curious and ingenious theory on the advantage of a small percentage of carbonic acid in the air. The sedative nature of this gas is well known, and with most animals in a state of nature sleep comes on at the time when plants commence to develop carbonic acid, that is at sunset, and it relaxes its hold about sunrise, when plants begin to exhale oxygen. Further, when man and animals compose themselves to sleep, they not only do so in the position which gives the greatest relaxation to the muscles, but "they place the head so as to favour the accumulation of that gas about it, and consequently its inhalation. The head of a man, when at rest, generally lies low, on a soft and depressed pillow, those of most quadrupeds crouched between their paws, and those of birds nestled among the feathers of their backs or wings," so that in all those cases, owing to the low and confined position of the mouth and nostrils, much of the air must be inhaled again and again, and become gradually mixed with a larger proportion of carbonic acid. He also adduces the fact that the carnivora who are nocturnal in their habits retire during the day to deep and narrow caverns, in which the air, becoming vitiated by their respiration, tends to promote sleep. The obvious objection to this theory is, that the carbonic acid becomes rapidly diffused, so that the air in every part of the room would probably be found to be sensibly of the same composition.

ETCHING METEORIC STONES.—Professor Bottger gives the following as his method of etching meteoric stones, so as to render their internal structure visible. Nitric acid of 1·2 sp. gr. is diluted with an equal volume of water, and the stone, having been previously cut and polished, is placed in the solution. The sides and parts not required to be acted upon are coated with a solution of asphalte in benzole. To facilitate the action of the acid, the face of the stone is touched lightly from time to time with a camel hair pencil, and after the lapse of five or six minutes the stone is taken out of the acid, and carefully washed, first in water, and then in carbonate of soda to remove every trace of acid. The stone is then dried, the asphalte dissolved off by turpentine, and the etched surface coated with a solution of paraffine in benzole, to preserve it from rust.

THE SPECIFIC FOR CATTLE PLAGUE.—Mr. Maurice Worms, of Ceylon, has introduced a new cure for the cattle disease. It consists of shalot, garlic, ginger, assafœtida, and rice water, and is said to have been tried with success in Lord Leigh's and Sir A. Rothschild's herds.

ART NOTES.

THE Birmingham Gallery of Fine Arts is to be open soon. The Department of Science and Art, South Kensington, has undertaken to contribute some examples for display. So wealthy a town as Birmingham ought not to be in need of loans of this sort—at any rate, for no long time together. There is no town in Britain where so much art or manufacture is needed as in the Midland metropolis.

AT last the public have an opportunity of seeing Mr. Maclise's water-glass picture, "The Death of Nelson," which decorates the Royal Gallery at Westminster; that is, the picture may be seen as well as the arrangements for lighting the chamber permit; also, the "Interview between Wellington and Blucher after Waterloo." Tickets, obtainable by application, on Saturday afternoons, at an adjoining office, immediately admit the visitors to the Royal Gallery and other parts of the Parliament House.

THE Council of the Institute of British Architects proposes Mr. Butterfield as the recipient of the Gold Medal for this year.

MR. FOLEY's model for the bronze statue of Lord Herbert of Lea, which is to be placed in front of the War Office, Pall Mall, is complete. It exhibits the deceased minister standing in his peer's robes, the head resting upon the palm of one hand, which is sustained at the elbow by the other.

A BILL has been printed and brought into the House of Lords by Lord Stanley of Alderley, providing that the owner for the time being of any work of art may, without incurring any responsibility for any consequent loss or injury, lend such work to the Lord President for the time being of her Majesty's Privy Council, for any period not exceeding twelve months, to be exhibited to the public by him or by his direction at the proposed exhibitions of national portraits, and the Universal Exhibition of Paris next year. The expression "owner for the time being" will include trustees of museums and other bodies of persons, whether corporate or unincorporate, having in their possession or under their control works of art, on trust for any public purpose.

RUSSIA extracts gold from her Siberian province to the value of twenty-two million roubles annually.

IT is possible that the present Congress will introduce the French system of weights and measures into America.

THE consumption of oxygen by animals varies directly with the surface, and inversely with the bulk of their bodies.

LEAD is said to be always found in the ashes of marine plants—usually about an 18-1,000,000th part.

PHOTOGRAPHIC NOTES.

THE CATTLE PLAGUE AND PHOTOGRAPHY.—We understand that the price of hyposulphite of soda is rising, in consequence of a large consumption as a remedy or preventive in the cattle plague. Iodine is also used to destroy contagion in the same disease, and is, in like manner, increasing in price.

NEW USE OF PHOTOGRAPHY.—In the case of the skeleton recently discovered near Waterloo Bridge, a set of false teeth would afford, it was hoped by the authorities, some clue to the identity of the body. To this end the Dentological Society had the teeth photographed, with a view to publishing a copy in the Journal of this Society, and thus readily securing indentification.

THE MAGNESIUM LIGHT.—We understand that some improvements in lamps for burning this wire have been effected in America. Hitherto the lamps have failed because a continuity of the lights could not be guaranteed. This defect originated through the oxide of magnesium (*i.e.*, magnesia) accumulating about the points of combustion, and thus preventing that free rush of oxygen necessary for the conservation of the flame. In the new lamp this accumulation is removed as constantly and as regularly as it is formed. Two moving agents are used; one, hooked like the bill of a bird, and working from right to left, clears off all oxide from the exit tube, while the other acts as a pair of snuffers, and cuts off the pendent oxide.

EMPLOYMENT FOR WOMEN IN CONNECTION WITH PHOTOGRAPHY.—Madame Una Howard has been for some time endeavouring to form an institution for teaching ladies in reduced circumstances the art of colouring photographs. The Marquis and Marchioness Townshend and the Countess of Fife recently visited Madame Howard's studio, and became patrons of the institution.

TONING BATH FOR POSITIVES.—Three or four grains of caustic potash are dissolved in water in a glass vessel, and the solution is supersaturated with benzoic acid. The first portions of acid dropped into the potash dissolve instantly, by combining with the potash, and when a fresh addition refuses to dissolve after a few moments, it may be concluded that enough has been added. The solution is then to be warmed till the remaining acid dissolves. Three or four grains of chloride of gold in solution are then added, and the whole diluted so as to form a bath of eight or twelve ounces. The bath thus prepared is ready for immediate use, and has excellent keeping qualities. Albumenized paper is toned by it to nearly the same warm shades as with the acetate of soda bath, comparison resulting in favour of the benzoate bath, as the more certain and regular of the two. The prints do not require over-printing.

GLEANINGS FROM SCIENTIFIC WORKS.

THE sensation upon the ear, connected by means of a tube with water in sonorous undulations, was found to be much greater than that upon the ear connected with the same water by means of a solid rod. When both tube and rod were employed simultaneously sound was heard only in that ear supplied with the tube.

A SAMPLE of pig iron which, after having been re-melted and kept 15 minutes in fusion, bore a strain of 20,336 lb.; bore, when kept in a state of fusion for 2½ hours, 27,456 lb.; when 4½ hours in fusion, 29,227 lb.; 6¾ hours, 36,312 lb.; and 7¾ hours, 37,552 lb. the square inch. The density rose from 7·175 to the first, to 7·343 in the last experiment.

ONE cord of ordinary pine-wood of 128 cubic feet produces gaslight equal to 800 lb. of spermaceti candles; one cord of oak or maple, of good quality, will yield gas-light equal to 900 lb. of spermaceti candles. This estimate is formed upon wood used without careful drying; when this, however, is thoroughly attended to, a cord of pine wood has produced a light equal to 1,300 lb. of spermaceti candles.

COLOUR-BLINDNESS is applied not to a disease of vision, but rather to a remarkable type of vision. Dalton, discovered his colour-blindness by hearing a geranium called red, which he had thought light blue. Dugald Stewart could not tell a cherry from its leaves, except by the form.

SEVENTY-EIGHT parts in the hundred of blood, and seventy-two parts in the hundred of muscle, are water. Prof. Owen has estimated the solid matter of a jelly-fish, weighing two pounds, at sixteen grains. Some water plants consist of from 90 to 95 per cent. of water.

M. BOUSSINGAULT has shown that nitrogen is an indispensable ingredient of manure, without which neither phosphate of lime nor any other alkaline salt can produce any useful effect. From experiments he arrived at the conclusion that the atmosphere alone cannot furnish plants with nitrogen sufficient for vigorous vegetation.

ACCORDING to Dr. Franz an absorption of 3·54 per cent. takes place during the passage of heat through a column of air 90 centimetres long; for coloured gases the absorption is greater, but all colourless gases now show marked divergence from the atmosphere.

IT is stated that if a person placed in a room heated to 20 deg. Centigrade, plunges his naked arm into a receiver full of carbonic acid gas, a sensation is experienced as though he had put his arm into something 15 deg. or 20 deg. hotter than the air of the chamber.

A FOREST intervening between a pestilential marsh and a city often affords a protection to the inhabitants; and perchance the pestiferous air becomes decomposed into innocuous gases during its enlargement among the trees.

ALLOYS in which the preponderating metal is the worse conductor of heat present the curious result that they conduct heat as if they did not contain a particle of the better conductor; the conducting power of such alloys being the same as if the bar used in the experiment were entirely composed of the worse conducting metal.

MR. HERAPATH states that he was unable to detect the smallest trace of phosphorus in the bodies of the fire flies. His opinion is that the light is caused by the burning of a peculiar compound of carbon and hydrogen, formed in a special gland.

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THE SPECTROSCOPE AND THE MICROSCOPE.

A VERY ingenious spectroscope, perfectly new as to details, has been constructed by Mr. Browning, and has been figured and described by a popular and valuable scientific monthly. This spectroscope is stated to be admirably adapted to microscopic investigations. Mr. Slack explained Mr. Browning's instrument at a recent meeting of the Microscopical Society, and that gentleman represented it as working admirably, and with great facility on his instrument. The first step in the application of the spectroscope to the microscope was made by Mr. Huggins, who communicated his ideas to the Microscopical Society in May of last year. In this plan an adjustible slit is placed three or four niches behind the object glass, "behind the slit at its own focal distance is placed an achromatic lens," which transmits parallel rays to an angular shaped spectroscope. In the aforesaid communication, Mr. Huggins says—"The spectrum of any part of a microscopic object could be examined apart, and also can be compared with the spectra of adjacent portions of the object. In this manner the spectrum of a single blood disc, or the spectrum of the contents of a single cell, can be observed, and any changes in living tissues which cause a modification of the spectrum, can be watched and investigated."

Respecting the application of the instrument to opaque objects, Mr. Wenham, who assisted Mr. Huggins in some of his investigations, says—"We are able to make an analysis of the smallest microscopic object, such as the smallest portion of a blood disc, mounted in the ordinary way. We can get a strong spectrum, and the power of the object glass gives a better result. . . . . We found some curious results from investigating opaque objects. In all spectrum analysis the difficulty is to get a monochromatic light. Generally we get a spectrum of some sort; but from the surface of many opaque objects the reflected light is perfectly monochromatic."

Mr. Slack also stated that he had tried a direct vision spectroscope made by Mr. Browning, and that an instrument of this description would be convenient for use with the microscope. It is a compound prism, giving direct vision and having an amount of dispersion very well adapted for the exhibition of delicate absorption bands.

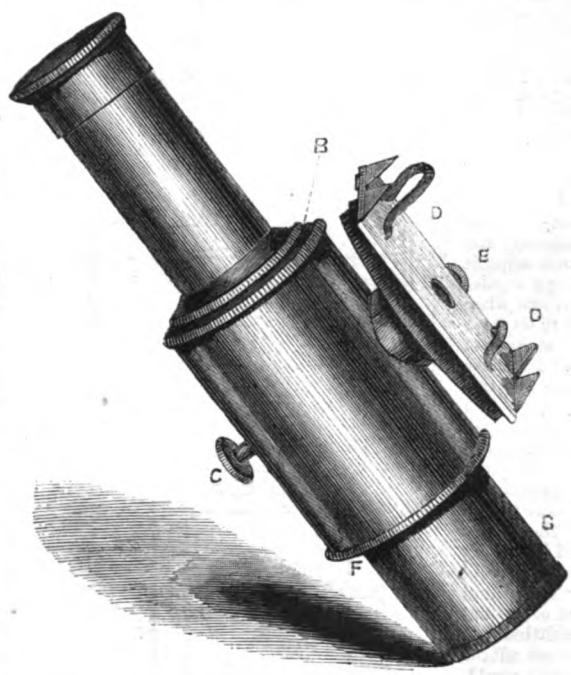
The new spectroscope may be used under the stage, when required; but its most convenient place is that of an ordinary eye-piece. The prism is contained in a small tube, removable at pleasure. Below the prism is an achromatic eye-piece, with adjustible slit between the two lenses; the upper lens furnished with a screw motion to focus the slit. A side slit capable of adjustment admits, when required, a second beam of light from any object whose spectrum it is desired to compare with that of the object placed on the stage of the microscope. This second beam of light strikes against a very small prism suitably placed inside the apparatus, and is reflected up through the compound prism, forming a spectrum in the same field with that obtained from the object on the stage. Any small object can be brought into the field and focussed. The prism is taken off and the slit opened by turning a screw. The apparatus then acts simply as an eye-piece, and a single blood disc may be brought exactly in the middle of the field. The spectroscope slit may then be closed so as to isolate the blood disc from similar discs on either side of it, and then a small shutter, worked by another screw, diminishes the length of the slit to any extent required, and the blood disc, or other minute object, is seen in a little optical cage, which shuts out the view of other bodies. The prism is then replaced, and if all the adjustments are in order, the absorption bands produced by blood are distinctly seen. With care it is easy to operate in this way with an object glass as high as Smith and Beck's 1-20th.

Important results may arise from Messrs. Huggins's and Wenham's micro-spectroscopy of opaque objects. To indicate this, it is only necessary to state that with a two-thirds or half-inch objective a good spectrum can be got from a portion of blood dried on a card or a bit of glass, and not bigger than a full stop in small print. A similar portion of dried blood may be viewed conveniently with higher powers as a transparent object.

Solutions and fluids of various kinds may be placed in small cells, or minute drops of various substances may be placed upon a glass stage and their spectra examined before and after reagents are applied. The small drops required can be handily taken up by glass rods drawn out to the thickness of a needle, and having a little crook at the end. The glass stage should have the bottom ridge turned in at an acute angle, and glass sides, by which means the fluids are prevented from escaping on the stage. Unless very small drops are placed on this glass stage they run down too easily and spoil the experiment.

With the view of this spectroscope, and a description of the parts, our readers will find little difficulty in applying it to their microscopes.

A is a brass tube carrying the compound direct vision prism. B, a milled head, with screw motion, to adjust the focus of the achromatic eye lens. C, milled head with screw motion to open or shut the slit *vertically*. Another screw at right angles to C, and which from its position could not be shown in the cut, regulates the slit horizontally. This screw has a larger head, and when once recognised cannot be mistaken for the other. D D, an apparatus for holding small tube, that the spectrum given by its contents may be compared with that from any other object on the stage. E, square-headed screw, opening and shutting a slit to admit the quantity of light required to form the second spectrum. Light entering the round hole near E, strikes against the right-angled prism inside the apparatus, and is reflected up through the slit belonging to the compound prism. If any incandescent object is placed in a suitable position with reference to the round hole, its spectrum will be obtained, and will be



seen on looking through it. F shows the position of the field lens of the eye-piece. G is a tube made to fit the microscope to which the instrument is applied.

To use this instrument insert G, like an eye-piece, in the microscope tube, the slit at the top of the eye-piece being in the same direction as the slit below the prism. Screw on to the microscope the object glass required, and place the object whose spectrum is to be viewed on the stage. Illuminate with stage mirror if transparent, with mirror and lieberkuhn and dark well if opaque, or by side reflector, bull's-eye, &c. Remove A, and open the slit by means of the milled head, not shown in cut, but which is at right angles to D D. When the slit is sufficiently open the rest of apparatus acts like an ordinary eye-piece, and any object can be focussed in the usual way. Having focussed the object, replace A, and gradually close the slit till a good spectrum is obtained. The spectrum will be much improved by throwing the object a little out of focus.

Every part of the spectrum differs a little from adjacent parts in refrangibility, and delicate bands or lines can only be brought out by accurately focussing their own part of the spectrum. This can be done by the milled head B. In delicate investigations, this direction must be carefully attended to.

This spectroscope can be fitted so as to go under the stage of any microscope if required. When the spectra of very small objects are to be viewed, powers of from ⅛ inch to 1-20th, or higher, may be employed.

Blood, madder, aniline red, permanganate of potash solution (quite fresh) are convenient substances to begin experiments with. Solutions that are too strong are apt to give dark clouds instead of delicate absorption bands.

PHOTO.-PANORAMIC APPARATUS.

TO the many marvels and beauties of photography, we shall now probably be able to add the grand and splendid effects of the panorama. At the meeting of the Société Française de Photographie, December 1st, a communication on this subject was received from M. Martens, the details of which are as follows:—

If we shut one eye and look straight before us, we shall see with precision only a limited extent, all the other points of space to the right and left will be but vaguely seen. The objective produces exactly the same effect, which led M. Martens to the idea of mobilising the objective, so as to keep it always opposite to the object to be taken.

His first dark panoramic chamber for operating on a plate was presented by the celebrated F. Arago in 1844 to the Institute.

Later he operated on the same system, but modified so as to receive a glass in the place of the plate. He is in possession of stereotype plates of the Rue de la Harpe while it was being taken down, which proves the priority of this system.

He can change the objective at will, and make the apparatus turn round completely upon itself, so as to obtain, if he is on a culminating point, a complete panorama. The quickness of the movement of the apparatus may be regulated on the spot in the most simple manner, according to the peculiarities of the view, or the state of the weather.

The objective being always at the same distance from the glass, the focus is always the same, and the result, notwithstanding the length of glass to be gone over, of equal fineness.

By very simple means the intensity of the light may according to necessity be modified so as to modify its own action.

M. Martens operates on glass, dry, by the tannin process, or moist, but he is persuaded that with a very sensitive preparation, he could take persons, carriages, clouds, &c.

All the operations are the same as with the ordinary apparatus.

AERONAUTICS. — A Parisian speculator proposes to organise a balloon service to ply between the Place de la Concorde and the Champs de Mars during the Universal Exhibition of 1867.

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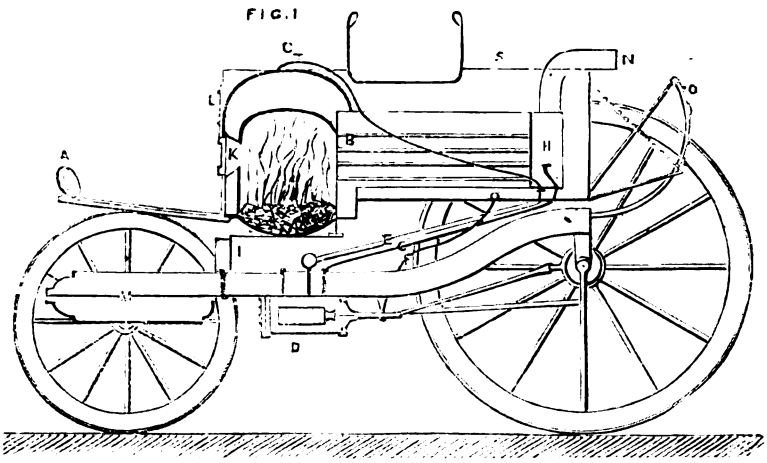
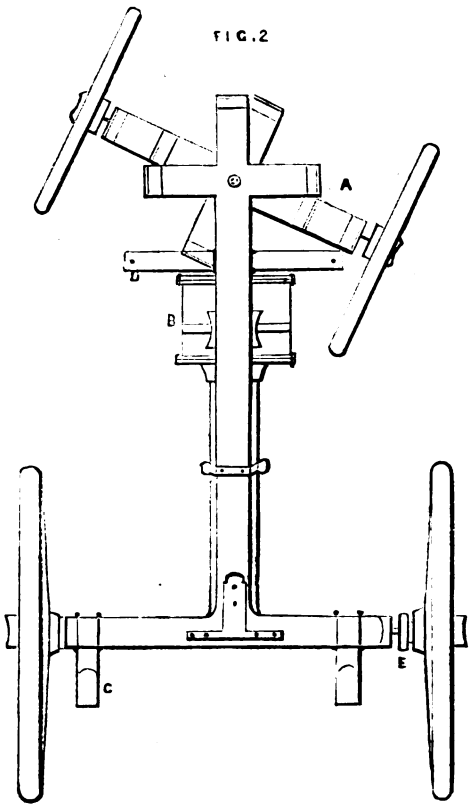
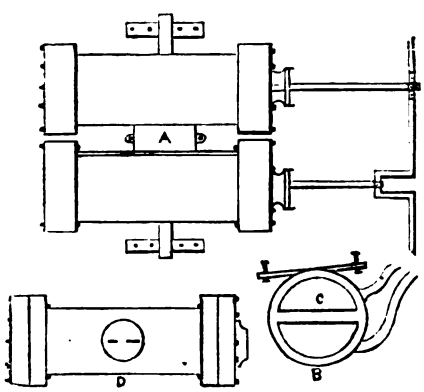
ROAD LOCOMOTIVE.

A correspondent, A. W. Forbes, sends us from Edinburgh a host of illustrations of a road locomotive, which he has constructed, in the hope that they would be of service to his brother readers. We have reduced the whole series into three, which we think will sufficiently explain Mr. Forbes' ideas. Fig. 1 is a section of the "steam drag." A is the pressure gauge, the tube of which runs under the foot board to top of boiler, B, which is of copper with fifteen 1¼ inch tubes. This boiler is made like a railway boiler, all but the fire-box, which is round instead of square; C, steam cock; D, pair of cylinders, 10 inches by 4 inches; E, steam pipe with ball sockets; F, feed pipe, of India-rubber; G, waste pipe leading to smoke-box; H, I, front spring; K, fire door; L, water gauge; M, lock-wheel; N, chimney, with cover to keep it off the seat (s); O, hind springs. In Fig. 2—under carriage, A is the lock wheel, drawn aside to show the work; B, cylinders; C, springs; D, front spring; E, clutch (see English Mechanic, Feb. 3). Fig. 3 shows a pair of rocking cylinders better adapted for the work, and requiring less room. A, is the steam-box, which supplies both cylinders; B, steambox, inside shape; C, a Papin's two-way cock, for reversing, by allowing steam to enter the top or bottom division of steambox, C, C; D, shows the steam ports.







WORKING MEN'S HALL, WHITTLESFORD, CAMBRIDGESHIRE.

In the village of Whittlesford, seven miles from Cambridge, Mr. Robert Maynard, who carries on an extensive business there as an engineer and manufacturer of agricultural implements, has liberally bestowed the sum of between £500 and £600 on a Working Men's Hall, for social meetings and intellectual recreation, under the auspices of the Working Men's Club and Institute Union, whose head-quarters are at 150, Strand. Mr. Maynard, having lived in the village fifty-seven years, and being a large employer of workmen, came to the opinion that the habit of frequenting the public-house was the cause of nine-tenths of the crime and misery in his neighbourhood; and he went on to make the following most sensible reflections, which shall be given in his own words: "But a man cannot always be at work, and when work is over he does not always want to sit over his own fireside. He wants sometimes an hour of recreation or relaxation for his mind in the society of his fellow workmen. Where is he to get this but where members of his class congregate? And their only place for meeting in this, and in most other villages, is the beer-shop or the public-house. I believe that not one-half of the men who frequent such places, and in time become confirmed drunkards, went there at first for the sake principally of drink, but for society. Had there been other places of resort where they could have had the same sources of enjoyment—the society of their fellows; the comfortable, cosy room and cheerful fireside; the newspaper, the occasional enlivenment of music, the quoits, the skittles, and the other attractions which a public-house affords (the intoxicating draught excepted)—they would, unless they had become previously contaminated, as soon have resorted to such a place as to the public-house."

With this conviction, and thinking an institution of the kind might be established as well in a village as in a town (the population of Whittlesford parish being 800 souls), Mr. Maynard purchased a piece of ground in the centre of the village, erected a building containing a fair-sized room with a fire-place at each end for a social room; a library and a reading room over it; a lofty hall about twenty-five feet square; a music room and a kitchen; the whole, by the easy removal of partitions, convertible into one spacious room, with a platform at the end and a retiring room beneath it, so as to suit it for a lecture or concert room, and sufficiently large for the accommodation of about 500 persons.

ELECTRO-METALLURGY.

THE batteries illustrated in the last number nearly complete the stock in trade required by an amateur electro-metallurgist, and he may now commence in earnest. I say he, but at the same time recommend the study to females.

I am about to recommend some subjects for typing, but my students must persevere copying the scratches upon a flat piece of copper or the penny piece before they attempt these.

Cameo Brooches.—Many of these are worth possessing copies of. Take a mould in gutta percha, it will not injure the setting. Be careful to have a really good mould, and then any number can be copied from it, and when electro-plated or gilded, looks beautiful, and may be worth setting; but if the mould is defective in the slightest degree, the plating or gilding makes the defects tenfold more apparent.

Cameo studs and breast-pins come under the same head.

Ancient coins or engravings are good subjects, but practise first upon such as you do not mind spoiling.

Plaister casts.—In some towns these are to be bought in great variety, and all sizes, cheap. I obtained one 18 inches by 12, "Our Lord's last Supper," for eighteenpence. Such subjects typed are worth much more.

To prepare them for the bath cover the back with warm white wax, and hold near the fire till the plaister has absorbed as much as possible; treat the front with boiled linseed oil, and allow it to stand three or four days. The plaister will then take a smooth polish from the hand, or a soft black-lead brush. Apply dry black lead until the surface is bright; be careful that the lead is not in heaps at the angles. Fix a wire round the surface in contact with the lead, and it is fit for the bath. From this you obtain a metallic negative. If the subject be large it is difficult to obtain an even deposit, it frequently coats in patches; if after a few hours it is not covered, better remove from the bath, wash in clean water, dry and repolish for another effort. Practice upon small objects teaches this better than I can.

I need scarcely mention that the plaister original is spoiled for any other purpose.

Some objects can only be copied in plaister, or it is desirable to take them so, fish, &c. Some practice as well as instruction is required before it becomes easy. For practice try something easy. A small spoon for instance; surround it with a thick cardboard frame on a greased board, a moulding box that readily takes to pieces, or a cardboard box. Next procure a quart basin and half fill it with water. Sprinkle in small quantities the finest plaister of Paris, and stir till it thickens. Pour this upon the floor of the box, and press the spoon slightly greased upon it. Let the highest part of the spoon be imbedded half way in and before the plaister sets, remove as much as possible from the sunken parts; set aside to dry; in about twelve hours trim the plaister with a knife or the edge of a flat piece of steel. Dig with a penknife three or four holes in the plain portions, and oil well all over. Supply the mixed plaister as before, but only a small layer first, and pass a camel-hair brush several times through it over the spoon to remove air-holes; when set, add plaister to the thickness required. In twelve hours or sometimes less, remove the cord and separate the halves, and the patterns should be perfect. On your skill and patience much depends.

Momus.

It has been computed that 800,000,000 gallons of fresh water, in a tolerable state of purity, derived from the various sources and tributary streams of the Thames, descend through Teddington lock every twenty-four hours.

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THE LATHE AND ITS USES.*

VII.

CHUCKING (*continued*).

The chuck is a very necessary and even indispensable auxiliary when chasing. Threads cannot be caught in the jaws of a scroll chuck because, if set tight enough to hold the work, the threads are jammed so that they will not run in the part they were fitted to. If a piece, having a thread cut on it like Fig. 24, is to be turned outside, it is very easy to chase the cap first and then the cup it fits, so that the cap can be screwed into it and turned off where it belongs; it will then be true, and is easy to mill on the edge.

FIG. 24.

It must always be borne in mind that the chaser must be sharp. If it is not, drunken threads will be the rule, not the exception.

METAL SPINNING.

Spinning sheet metal into various forms is another kind of work which can be done in the foot lathe, and it is here that the amateur can show his taste and dexterity.

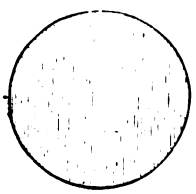

FIG. 25.

The process consists in forming a blank, like the engraving, into an ornamental base for a lamp, or an oil cup; in fact, anything whatsoever. All that is requisite is to have a fac simile, in wood, of the shape you wish to make. This is bolted or otherwise made fast to the face plate, and the blank is then set up against it, and held as the cylinder head shown in Fig. 21, is; that is, with a rod leading from the back centre of the lathe to the work.

A tool like this is then used to press the metal into all the recesses, or curves of the pattern. The speed must be high and the metal quite soft, and moistened with a little soapsuds or oil, so that it will not be scratched by the tool.

FIG. 26.

To spin metal requires some dexterity, but it is easily acquired after a little practice. The rest must be furnished with holes like this figure, and a pin, so that the tool can be brought up against it like a lever.

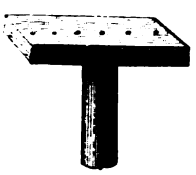

FIG. 27.

Still another kind of metal spinning can be done in the lathe. This relates to making circular shapes, or cylindrical, more properly—such as napkin rings, the tops of steam pipes, or similar things. To do this a mandril is requisite. The mandril must be of steel and turned to the desired pattern—like this, for instance:

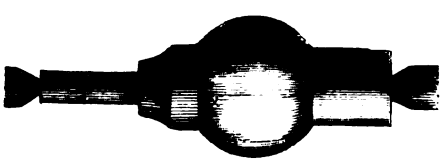

FIG. 28.

A ferrule is then made and soldered together with lopped edges, so that there will be no seam. The mandril must be as much smaller than the size of the finished work as will allow it to come off freely, for it will be apparent that if the work was spun up *on* the mandril it could never be taken off. The ferrule when put on them will stand eccentric to the mandril, as in this figure—that is, when the tool bears on it. In other respects the process is just the same as spinning on the face plate. Tripoli, chalk, whiting, rotten stone, and similar substances, are used to give the fine polish on such work.

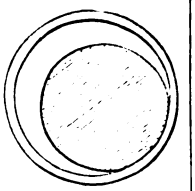

FIG. 29.

We know of no prettier or more expeditious process of making a small steam boiler for a toy engine, than by spinning it upon the lathe. The boiler will be very strong, have large fire surface, and be without joints, having only one at the bottom, where it is easily kept tight. Fig. 30 is the boiler.

The metal must be thin (twenty gauge), the sheet brass sold in the shops will answer, as it is already annealed, and the corrugations must not be too deep on the sides, or the work will not come off the mould. The centre of the fire-box, A, must be left flat so that the flue will have a bearing on it. For a small engine, 1-inch bore and 2-inch stroke, a boiler of the dimensions given here is ample. The flue must be brazed or soldered at A, and the bottom must be riveted at B, for every two inches; this is not necessary, however. There are only three pieces in this boiler—the shell, the fire-box, and the flue, and the water must not be carried more than three-fourths of an inch over the crown of the furnace.

We shall now again revert to cutting tools.

Probably many of our readers, who use hand lathes not furnished with slide rests have wished for that indispensable appendage where boring is to be done. For ordinary turning, we do not appreciate a slide rest on a hand lathe so much as many do that we know, but for boring out valves, cocks, or, in fact, anything, a chuck and a good slide rest are invaluable.

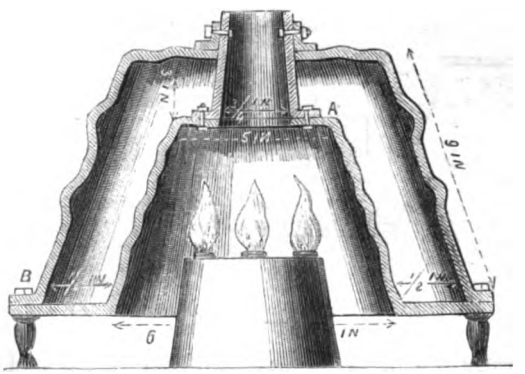

FIG. 30.

Some persons are always "meaning" to do a thing, yet never do it. Sometimes, for the want of facilities, at others for the lack of an idea. If the latter be of any value we can furnish one or two on this subject that may be useful.

One way to bore out holes parallel, without a slide rest, is to do it with the spindle of the back head. With a tool of peculiar construction, holes varying in size can be bored beautifully in this way. We present a view of such a tool in Fig. 31.

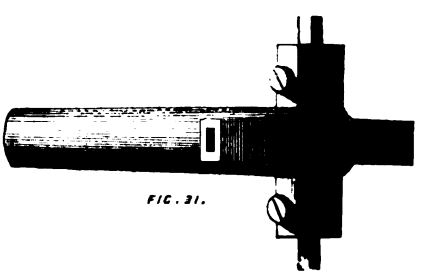

FIG. 31.

It is merely a cross formed on the end of a centre fitting the back spindle, the same as the lathe centre does. The arms of the cross are made stout and thick so as to admit of a square hole being cut in them. The hole is made by drilling in and driving in a square drift afterward to take off the corners. The shanks of the tools are well fitted to these holes in the arms, so that a slight pressure of the screws in the side of the arm will hold them steady. When used the tool is put in the back spindle, and the cutters set to the size required, or less, if there is much to take out, and run through the work in an obvious manner. Any

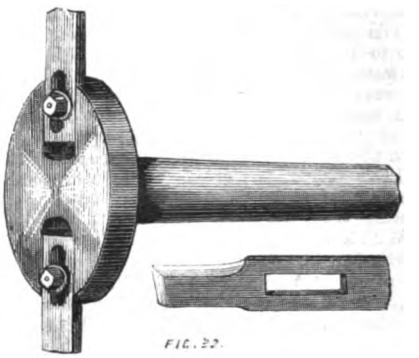

FIG. 32.

range of size can be had up to the diameter of the cross. It is not well to run the cutters out too far, however, as they will jump and chatter, or spring, and make bad work. The tool is so easily made that one can afford to have three or four for different jobs.

Another plan, but not so good, is to make a common centre and disc, like Fig. 32.

Here the cutters have a slot in them which a bolt passes through and screws into the disc; a small piece of wood put at the bottom of the tool, between it and the cutter, prevents it from slacking off so as to diminish the cut. These tools will be found useful and will do good work if properly handled. This latter tool is better for wood, but will answer for any metal by varying the cutters. To make a slide rest in the common way is a costly and tedious job. For all purposes of boring, a good one may be made as shown in the engraving, Fig. 33.

This is simply a casting fitted with a screw and spindle, as shown. The spindle has a tool let in the front end and held there by a set screw, and there is a wheel at the back end to run the spindle in and out. The casting has a leg to it which enables it to fit the common post the rest for the hand tool fits. There is also a key to prevent the spindle

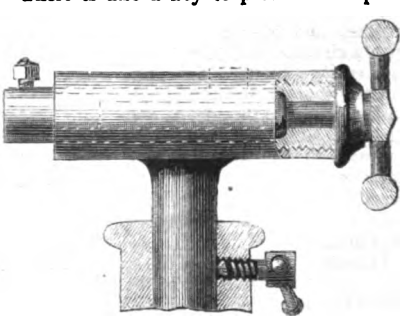

FIG. 33.

from turning round. By this arrangement it is easy to bore, not only parallel holes of any size, but tapering ones, which is often a great convenience. By a simple change of tool it can also face off any casting, and can easily be made to cut a thread of a given pitch by an ingenious workman. Not only this, but it can also be made without planing or other work most amateurs have no facilities for. It is within the range of ordinary lathe work, and will be found indispensable. The T-head may be of cast iron, but the spindle should be steel, with a brass nut let in the back end for the screw to work in.

* Mostly compiled from the American Journals.

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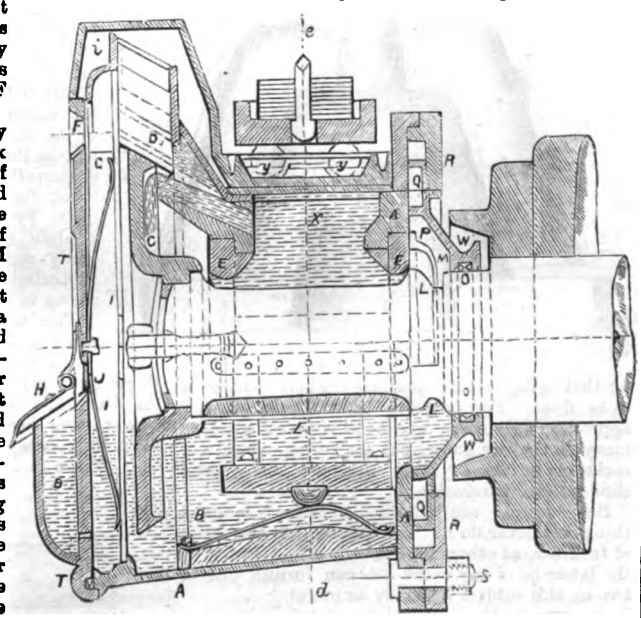
WATER AS A LUBRICATOR.

FOR some four months past an improved water lubricator, the invention of Messrs. Aerts Brothers, has been in use on the North-Eastern Railway, and in the *Mining Journal* of Dec. 16 it was mentioned that the results obtained were highly satisfactory. The experiment in question has been under the superintendence of Mr. De Pelsenaire, of Gateshead, by whom a carriage for that company was fitted with two of Aert's boxes on September 4 last, since which date, with the exception of a few days, that carriage has been and is still running daily with excellent results. Up to the beginning of October it was in use between Newcastle and York, and since that date between Newcastle and Normanton. The boxes and bearings remain perfectly cold even when running express. The mileage run by the carriage with the water-box up to this date is about 23,500, and this without any grease having been added to the thinnest possible coating which was put on the bearings when the boxes were fixed.

With a view to show the superiority of water lubrication as compared with soil, an elaborate report has been prepared by Mr. E. Despret, chief engineer of the Belgian Central Railway, and translated into English by Mr. De Pelsenaire. It is contended that oil is superior to grease as a lubricator; that the use of oil is very objectionable and expensive; that the defect of both oil and grease is their "alterability" as lubricating substances; and that no system of box whatever, no matter how perfect it may be, can remedy that. The construction of the water-box will be best understood from the subjoined diagram, which represents a longitudinal section of the box through the axis of the axle:—



The body of the box A is cast in one piece. Its front side is closed by a plate T fastened by four screw-bolts; this plate has at the top a circular opening F closed by a spring, and at its lower parts a cup H closed by a lid. The front side of the box is made water-tight by means of a small india-rubber band placed in a circular groove V of the plate in front. The back part of the box is closed by the disc M applied to the back of the journal, and which is kept tight against the box, by means of a plate R fastened by bolts S, and rendered water-tight by a india-rubber washer Q, whilst a leather washer O prevents the escape at the back between the disc and the back of the journal. On the end of the journal is fixed a cast-iron bevilled wheel C, by means of a key and central bolt acting upon a circular shell-like plate as on a spring; between this plate and the journal an india-rubber washer is placed in order to give elasticity. At the upper part of the box, and on the conical wheel, rests a spout D, the end of which moves freely in a vertical groove made in the body of the box; above this spout an appendix (*i*) is fixed in the shape of a reversed gutter to stop the water which might ascend by the end of the spout, and to throw it back into the lower part of the box. The upper part of the box is hollow, and its front part is prolongated as an inclined plane touching the spout. A thin rolled iron plate is adapted against a cast-iron rabbet in the body of the box, and is held in its place by a spring J. This plate forms at the front part of the box a separate compartment, to prevent extraneous matters, which might be in the water, from penetrating in the box, such matters falling to the bottom. A series of small holes, bored in the rolled iron plate at a height of from 1 to 2 inches from the bottom, allow the water to flow into the box. The socket E is grooved lengthwise, as well as the part of the box against which it rests; at the back of the socket a kind of vault P, in the shape of a horse shoe, is affixed descending below the centre of the journal. This appendix is to prevent the water escaping from behind the socket from being vertically projected against the inside of the disc M, and thus escaping by the back of the box. Against the lower part of the journal a greasing brush Z is fixed by means of a spring. Finally, in the nave of the wheel a circular recess W is turned covering the back of the disc M, and preventing the dust from entering at the juncture of this disc with the axle. This recess can be made by means of a collar shrunk upon the nave.

Before putting the box together, all its inner parts are to be covered with a thin coating of pure grease, or of any other greasy substance, laid on warm by means of a brush, to prevent the water from coming in contact with the metal. On the journal and socket a thin coating of grease is laid as well; lastly, the upper part of the greasing brush is coated thinly with grease also. The different parts of the box having been put together water is poured in, either through the opening F, or by the cup H, the water level in the box being regulated by the height of this cup. As soon as the vehicle is put in motion, the water, which is in the lower part of the box, is raised by the bevilled wheel, and carried to its circumference by the centifugal force. The water being stopped in its circular movement by the spout, falls over the inclined plane placed forward above the box in the cavity X, passes from there between the socket and the journal in the lower part of the box, where it is raised again by the conical wheel, and so on. There is, therefore a constant flow of water from the bottom of the box in the upper part, and the liquid flows constantly and abundantly between the two frictioning parts. Those parts having a thin coating of grease, the flowing water has no action whatever upon them, nothing but water and grease coming in contact together. There being no affinity whatever between these two bodies, and the water flowing constantly, the result is a rolling of the water, which lubricates in this manner the entire surface of the journal.

The extent to which the value of the invention is appreciated by the North-Eastern Railway Company may be judged of from the fact that the two first boxes fitted were supplied at the expense of the patentees, the railway company refusing to make any outlay, having no confidence in the system, but they have now given an order for four others on their own account, and Mr. De Pelsenaire is now busy fitting them to a first and second class composite carriage, which the company will commence running, for express service only, during the ensuing week, to serve as a final trial for the application of the boxes on a larger scale. It appears that in Belgium the system has already been largely adopted, and is at present working.

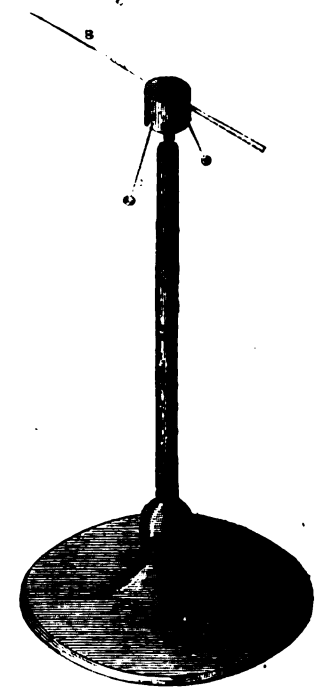
LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

MOUNTING A MAGNETISED NEEDLE.

Sir—Some time ago, wanting a simple and delicate method of mounting a magnetised needle, I found, after trying many plans ineffectually, the enclosed answering in every respect. Those of your readers who try it will find it very delicate, more so than would be expected.

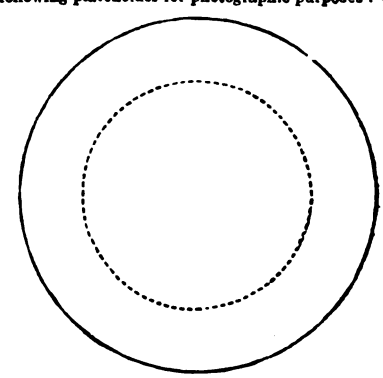
Having your needle magnetised, cut a piece of cork cylindrical of the following dimensions:—Height ¼in, diameter ¼in.; push the needle through the cork near the top, and in the bottom of the cork insert a part of another needle leaving the point projecting ¼in. Balance this on the top of a piece of glass rod by inserting pins loaded with small shot opposite each other on either side of the magnetised needle. The glass rod may be fastened to the feet of a wine glass by means of a piece of gutta-percha, or wood, or brass. If the cork be varnished with sealing wax varnish, it will be improved in appearance. The accompanying figure will illustrate this arrangement.



A, cork; B, B, needle; C, C, loaded pins; D, the point on which the whole is balanced. ALFRED P. WIRE.

PHOTOGRAPHIC PLATEHOLDER.

Sir,—Allow me to draw the attention of your readers to the following plateholder for photographic purposes:—



A. Brass pin of say ¼ or 3-16th diameter.
B. A hard wood cup of shape in section.
C. Disc of vulcanised india-rubber at least ¼ thick.
D. Brass disc nearly as large as bottom of cavity in B.
E. Brass nut to clamp india-rubber on D, and prevent entrance of air.
F. A cam jointed to A at H.
G. Rivets to secure a handle of wood to F with.

If you lay this plateholder on a glass plate and turn the handle from K over to M, you will elevate D and the india-rubber into the cavity of B, and thereby cause a vacuum. With a plateholder of this kind of 2½in. diameter I have worked plates of 11 × 9. It is advisable to wet the plateholder with water immediately before using it. The play of the cam for a plateholder of 2½in. need not be more than ¼in. You can have the handle which is nutted on to

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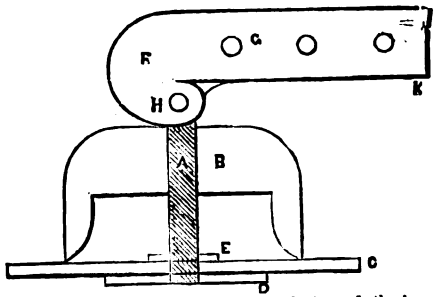
F of any length—mine was about 6in.—and thereby avoid staining your hands, cuffs, &c. The disc C must be of such a size that when D is elevated into the cavity of B, there may still be about ¼in of C, clear of edge of E. It is advisable to rub some old nitrate of silver over the brass



disc D, and india-rubber disc as when first used, the brass and free sulphur may destroy pictures—in fact, the longer this holder is used the less fear there is of stains, and the better it will hold on plates. I had another holder of about 3½in. diameter, but I find the small one sufficient for plates 11 × 9. W. J. CORRIGAN.

FRAMING PRINTS.

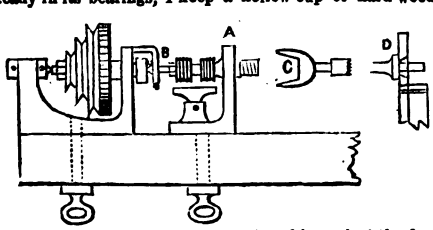
Sir,—Having observed in your columns some time ago a correspondence relative to the best mode of framing prints, may I beg your insertion of the following hints, which may prove useful? I have just removed a number of prints from their frames, in which they have been for at least sixty years, but probably for a longer period. None of them have suffered damage, owing to the following precautions having been taken. The glass of each frame is laid in with a composition like plaster, blackened to suit the dark frames; and, besides this, glass is pasted all round inside to the frame with a narrow strip of paper. Within the glass is the gilt moulding, which thus serves to keep the print and the glass a quarter of an inch apart. The print, being attached by its edges, or its corners, to the backboard, is put in over the gilt moulding, and the whole of the back securely pasted over with strong paper. The only prints I found to have turned yellow were those which were pasted on to canvas stretchers. This was probably caused by the paste.

I may add the following hints from my own experience. Prints (unlike oil paintings), if they are to be hung up, must have a glass over them, and be secured against the entrance of dust, flies, and damp. The paste to be used for all prints and drawings should be shoemakers' paste, which has, I believe, alum in it; and besides, not breeding insects, will attach paper to wood thoroughly. The putty, paste, &c., used must be quite dried after each part of the process of framing, before proceeding to paste up the back. The print itself must be also thoroughly dried. I believe that the spotty mildew often seen on mezzotints and dark etchings is as liable to come in portfolios as in glazed frames, and may have something to do with the ink; at the same time I do not think it would appear except where it is aided by damp. F.

LATHE RIGGING.

Sir,—In your interesting and instructive article for this week, on "The Lathe and its Uses," it is stated that any common lathe can be rigged for screw cutting with guide hubs. I quite admit this statement; but my own lathe and hundreds more of the same class do not admit of being rigged in the way there suggested for want of available space between the pulley and set screws. I therefore venture to send you a pen-and-ink sketch of a method which I have found sufficient for every ordinary requirement.

A, is a second head-stock, which may also carry a rest for the guide tools. B, is a second mandril with nose to fit same chucks as the original. This mandril carries the guide hubs, and runs between a collar in the second head-stock and the final centre of the original mandril. The two mandrils are connected by a common carrier on one, and a catch on the other. It is better that the two mandrils should join by male and female centres only, than by any solid junction, as in the latter case the slightest error in the centricity of the second collar might be injurious to the original mandril. The second mandril may be permanently fitted with any desired number of guide hubs, and if the last be made moveable, and fixed by a small jam nut, any special guide may be substituted at pleasure. To fix the second head-stock so that the second mandril shall run steady in its bearings, I keep a hollow cup of hard wood



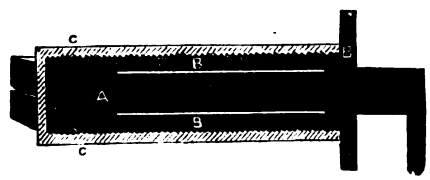
as shewn in section at C, and placing this against the face of the second head-stock over the nose of the mandril screw up by the back centre before screwing the second head-stock down to the lathe bearings.

Any handy amateur may fit the arrangement up for himself; for, as screw cutting is neither constant nor heavy work, a brass collar and plain steel mandril, unhardened, will answer every purpose. The only point requiring special care is the central position of the collar in the second head-stock, and the cup at C forms a ready means of working up the collar against a tool working from the mandril, while the head-stock itself slides on the lathe bearings. Those who already possess a boring collar have half the arrangement ready made, as the largest hole may be fitted with a brass collar as shown at D for the mandril to run in, and any slight modification may be introduced to make the chucks work clear, &c., &c. D. O. T.

BELLHANGER'S BRACE.

Sir,—In a recent issue of the ENGLISH MECHANIC, E. H. kindly offered assistance to bell-hangers, by giving the description of a new brace, which I think is not very practicable, as the screw will compel the bit to break if it cannot make its way easily. Some time since I saw a brace which I think a very much bettter one for the purpose in view. Perhaps the following illustration will be sufficiently understood.

A, is the centre pin of brace handle; B, section of inner socket, with thread on outside, and flange on outer end; C, section of outer socket, with wedge or other shaped catch on the back end, to fasten in the joist to prevent the handle from turning round.



In using, the wedge is placed on the beam opposite the hole to be bored, and the inner socket is screwed out by turning the flange on B with the left hand, which will force the bit as required. T. W.

OUR SUBSCRIBERS' NOTES AND QUERIES.

BOOKS WANTED.—Can any reader recommend me a good sound work on punching and shearing strain, and also a good work on wheels?—W. R.

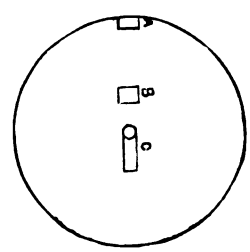
CEMENT.—I have a small soda water machine which is made of glass, the foot of which has been cemented to a stone china stand and is now separated. Will any reader inform me what cement to use for fixing it again?—SODA WATER.

SPIRAL GROOVE.—W. H N. will much oblige me if he will inform me how to cut a spiral groove of one twist in 12in. in a rod of brass ½in. in diameter? I have for some time been at a loss how to accomplish this.—A TURNER.

CUTTING SHOULDER ON THE LATHE.—Will any reader favour me with a few words of advice as to cutting a square shoulder to a piece of wood on the lathe? I can manage pretty well with ordinary work, but cannot get over a square shoulder without breaking the angle off.—A VERY YOUNG HAND.

TURNING.—I have a small lathe (a dentist's I believe), 2½ inch centre. Is this too small for brass-turning?—NEW SUBSCRIBER, X. × Y.

COUNTERBALANCE.—Will any reader inform me whether the counterbalance for a fly-wheel of an engine or machine ought to be fixed on the periphery, or at the same distance as the centres of the crank? Namely, suppose the crank to be 14in., should the counterbalance on the wheel be 14in. from the centre of the same? Also, supposing the weight to be on the periphery, would it make any difference if worked



at say 10 or 100 revolutions per minute? I enclose sketch showing the two weights. A, counterbalance on periphery; B, do. at 14in.; C, crank 14in.—R. W. B.

PUNCHING AND SHEARING MACHINE.—Can any of your readers tell me where I can get a punching and shearing machine, worked by hand (with fly-wheel or screw), that will punch a ¼in. hole in ¼in. iron, and cut just the same or less? A second-hand one preferred to suit a common COUNTRY SMITH.

FURNACE FOR WELDING TUBES.—I want a drawing of a good furnace for welding iron tubes, such as gun-barrels or gaspipes, etc. Perhaps some reader can furnish me either with the drawing or direct me to somebody from whom I can get it. I am prepared to pay a reasonable price for it.—PHILIP CARL.

DRY AIR.—I want to introduce a blast of cold air into a room, but in refrigerating the air, I wish it to be kept perfectly dry. Can any of your readers tell me the best way to effect this?—SCRUTATOR.

VIOLIN PURFLING.—Can any correspondent inform me whether, and if any, what machinery or special tools are used for cutting the grooves for purfling a violin? If none, describe a simple method of doing the same.—J. A. F. R.

SKELETONS OF LEAVES.—Can any reader tell me how to procure the skeletons of leaves quickly?—J. C. S.

HORTIS.—Can any reader tell me how to dry plants for a hortis siccus, or dry garden?—J. C. S.

INDIA-RUBBER BINDING.—Can any reader inform me where I can get a book bound with an india-rubber back, and without stitching by Hancock's patent process?—F. W. G.

STRENGTH OF TIMBER.—Will any subscriber favour me with a rule for finding the strength of timber. For example, suppose a beam 25ft. long. 5in. by 10in., what weight would that carry in the middle?—W. E. H.

ELECTRIC BELL.—Will any reader give me a few hints relative to the manner of fixing the wire of a bell, where the said bell is to be rang by an electric current? I believe the plan is in general use in the large hotels of Paris, and in some cases it is used in London.—ARNOLD HENRY.

TAPS.—Can any reader inform me how to flute taps in a screw cutting lathe?—C. W.

COOLING LIQUIDS.—Will any correspondent tell me if there is a small compact instrument for cooling, boiling, or warming water? I want plan and description. I see there is one in No. 31, Vol. 2, but I want one on a much smaller scale.—SLIDE RULE.

CARBON BATTERY.—Mr. Tonkes recently stated that he had constructed a very powerful carbon battery. Will he oblige me by giving such directions as will enable me to construct a battery like his?—H. BROWN.

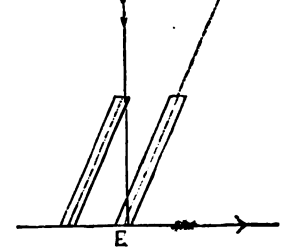
PHOTOGRAPHIC BACKGROUND. — In my photographic studio the background has been soiled by damp. Can any reader inform me how to make a paint to print it a dark slate colour without oil?—J. WATSON.

COPAL VARNISH.—Can any reader inform me the best and cheapest means of making copal varnish?—T. W.

HOFFMANN AND LIGHT'S BRICK-KILN.—Any reader who can supply me information as to who are the agents in this country for the above mentioned kiln will very much oblige.—J. W. R.

REPLIES TO QUERIES.

ABERRATION.—"Bickerdike" asks for "A mathematical demonstration of the curve of aberration." Inasmuch as his information on this subject appears to be of a somewhat imperfect character, I shall, perhaps, best succeed in making the matter clear to him, if I begin *ab initio*, and explain popularly what aberration is, employing only sufficient mathematics to render my remarks intelligible. Aberration, then, may be defined as that apparent displacement of a star which arises from the fact that light travels with a measurable velocity, and that the earth itself is moving with enormous speed in its orbit. A familiar example, employed by a great many writers on astronomy, may illustrate this. If rain fall perpendicularly upon a person at rest, he perceives that it is descending in perpendicular lines; but, let him run forward, and the rain will appear to him to beat against his face, and to come in a slanting direction from somewhere in front of



him. Now, in the figure I have drawn, let the tube E, held in the direction E s, remain stationary, and let a drop of rain fall from S; it will evidently fall against the inner side of the tube. If, however, we suppose that, during the precise time occupied by the drop in falling from s to E', the tube moves from E to E'; it follows that this drop will occupy the middle of the tube during its whole passage, and will seem to have come in the direction S' E'. The slant of the rain is measured by the angle S E' S', and, as the triangle s E E' is right-angled, E E' = E' s × tangent E s E', or what is, of course, equal to it, to S E' S'. That is to say—

Velocity of tubes = velocity of rain × tangent of slant. Now, then, let us suppose S to be a star, and s E the distance travelled by its light, in the time during which the earth moves from E to E', then the angle S E' S' is called the aberration of the star. So in fact

Velocity of earth = velocity of light × tangent of aberration, and consequently tangent of aberration $= \frac{\text{Velocity of earth.}}{\text{Velocity of light.}}$

Taking the velocity of light (as determined by the superb experiments of M. Fizeau) at 193,118·5 miles in a second, and solving this equation, we find that the aberration of any star equals 20″·4451. In the case of a star situated in the pole of the Ecliptic, it will appear, in the course of the year, to describe a minute circle with a radius of 20″·4451, about its mean place, whereas, a star in the Ecliptic itself is displaced only in that plane, and seems to travel in a straight line 40″·8902, long, or 20″·4451 on each side of its mean place. Intermediately between the Ecliptic and its Poles stars will seem to describe ellipses, all having major axes equal 40″·8902; the proportions of their two axes being in that of unity to the sine of their respective latitudes. I think that if "Bickerdike" will lay down the earth's orbit

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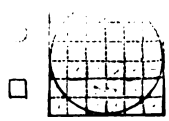
upon a piece of paper, and employing a pin's head to represent a star, and holding it above the paper over the mark he puts for the sun, draw lines from it to the earth, supposed to be in motion; and further conceive that the substance composing these lines takes a measurable interval to come from the pin's head to his moving earth, he will be able to realize to himself the effect of aberration much more vividly than he would ever be able to do from any amount of written description. A very little consideration will show him that as the earth describes an ellipse (which is not far from a circle) in the course of twelve months, any star in the pole of the Ecliptic must seem to describe its counterpart, and to be always 90 degs. in advance of the earth in its munature orbit. For further information, I would refer "Bickerdike" to almost any standard book on astronomy, or to that astonishingly cheap shilling's worth, "Main's Rudimentary Astronomy" in Weale's Series. — A Fellow of the Royal Astronomical Society.

Practical Photography.—I am obliged to "Old Hand" for his criticism; I shall ask his advice after a few brief remarks. On reference, I think that much is implied in the paper, which, perhaps, does not appear evident at first. I suppose no one would trouble to cleanse their Bath while it worked well; Old Hand forgets the adage that doctors differ; I stated as to using the same Bath for all purposes:—"I do not say that this plan is by any means accurate." If Old Hand will refer to Chapter IV. of Harvey, Reynolds, and Fowler's Manual, he will see there what will save me a great deal of writing—how that a bath with less iodide will not work graciously for more than a fortnight, and how it was made in splendid condition by being evaporated in the kitchen oven, &c. With all due deference to Old Hand's objection, I simply reply that I must beg to be allowed to differ. And now I want Old Hand's advice. He has taken a wet plate 2 miles to expose it, which, bye the bye, must be rather warm work for one of the hottest days in July; if I am correct in surmising that he ran 2 miles, exposed the plate, and then ran two miles back, and this in 35 minutes. Now will Old Hand tell me his exact manipulation; how was the plate looking half dry? What devel per was used? Any failure from crape lines or iron deposit? I should be glad with a rather full answer, as it may save me a deal of trouble. Thanks to Old Hand for his good opinion of at least some part of my paper.—Plodder.

Colouring Photographs.—H. Pin enquires how he may colour Photographs. In order to do so he must first remove the greasiness The photographs to be coloured must be sized with Isinglass to which is added a few drops of prepared gall; when dry, the colour must be stippled on.—C. Burgess.

Power of Microscope (No. 43) — The microscope advertised to magnify about 4,000 times is probably intended to magnify 60 diameters, or 3,600 times superficial. The annexed figure represents an object, round or square, 1-10th of an inch in diameter, magnified 6 dia meters, or 36 times. Though the advertised powers, when given in superficial measure, are seldom to be trusted, an object never looks so much magnified as it really is. Look through a microscope or telescope with one eye, and at the same object (unmagnified) with the other, and you will have a proof of this. The images may easily be made to coincide (apparently) on the retina of each eye.—J. H.



Speculum for a Telescope.—"Astro" will find the fullest detail as to grinding and polishing specula, in "Holtzapffel's Turning and Mechanical Manipulation," Vol. 3, pp. 1274 to 1295; in "Nichol's Cyclopedia of the Physical Sciences," pp. 675 to 680; in "Herschel on the Telescope," pp. 126 to 178, or in "Pritchard on Optical Instruments." He appears to wish to work a metallic speculum, the materials for which he could, of course, procure in Manchester; but, if he will take my advice, he will grind a glass speculum instead (any sort of glass will do, provided it be thick enough), and silver it by the process described by M. Petitjean at p. 148 of Vol 2 of the English Mechanic. It will not cost him a tithe of what a metal one would do, and will be easier to manipulate in every way.—An Amateur Turner.

Clear Varnishing Fret Work.—"Ubique" will find clear varnish at any of the London makers (ask for white hard varnish). All the best London pianoforte makers French polish the fret work. Surely this is delicate enough. In America the pianos are varnished and rubbed down with pumice stone, then finished with a coat of clear varnish. In this method there would be the rubbing, which would be as bad as polishing, and a fifty times longer process. I have no doubt they have better varnish in America than can be had in England. French polish will not stand the climate, which, doubtless, caused a search for better varnish.—A Fret Cutter.

Specula for Telescope.—If "Astro" will write to W. Smith, 43, St. Stephen's-street, Salford, he will obtain the required information respecting specula for telescopes.—J. L.

Grinding and Polishing Specula.—"Astro" will find ample instruction as to casting, grinding, and polishing specula in Edwards' treatise, annexed to the "Nautical Almanac for 1787," or in "Nicholson's Chemical Dictionary" (quarto), and in the Mechanic, Vol. 2, by James Smith, author of "The Panorama of Science and Art." I have made specula from 2½in. up to 8in. diameter. The best composition was 32oz. copper 15½oz. tin, 1½oz. arsenic, and ½oz. zinc. The zinc seizes what little oxide that may be mixed with the copper, and rises to the top, and is skimmed off as oxide of zinc. Use no more heat than is necessary, stir it well from the bottom of crucible to top, and when it shines like mercury, pour it off quickly into the mould, which should be of cast iron. Best copper about 11d. per lb.—Bar Tin 11½d. per lb.—may be had in Manchester.—P. A. Bowler.

Air-Gun.—Thanks to "John Agriculturist" for the description of his air-gun.—C. W.

Indian Ink.—In reply to a recent enquiry under this head, I send the following extract from an old work, entitled "Montgomery Martin's Eastern India:"—"A few persons live by making ink, which is kept both in a liquid and solid form. 95 s.w. of linseed oil, give 5 s.w. of lamp black, collected by an earthen lamp. Take 4 s.w. of lamp black, 5 s.w. of gum arabic, add a little water, and rub in an iron mortar with a wooden pestal for three hours; then infuse 1½ s.w. of gall nuts in 10 s.w. of water, add the strained infusion to the rubbed materials. Then rub again for three hours, then put the pot into the sun or a warm place, until the paste dries sufficiently to admit of its being made into small lumps or cakes."—George Dutton.

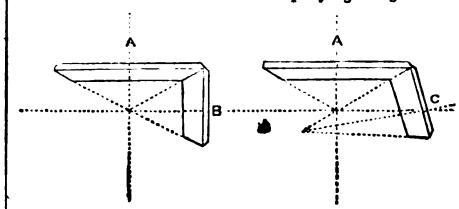
Soap Making.—In reply to Robert Marsh's enquiry I beg to say that he can derive much practical information on soap making in all its branches by consulting such works as Merfit's, Kurten's, and others, to be had from Messrs. Trubner and Co., or Messrs. Spon, viz., "A Treatise on Chemistry, applied to the Manufacture of Soap and Candles," price from 25s. to 30s. (Merfit's), "Kurten on the Art of Manufacturing Soaps, &c.," price 6s.—George Dutton.

Engine for Driving Boat.—R. T. asks for dimensions and price of a double engine suitable to drive a boat of 15ft. long. I have in my possession the castings requisite for the purpose. I designed them two years ago for a boat of 16ft long, but as I removed from a seaport town I abandoned my intention of finishing them. The cylinders are 3in diameter and 3in. stroke oscillating, and were originally intended to be inverted at an angle of 45°. The cylinders are not bored, but some filing work has been done about the steam chests, &c.—Locomotive, St. Helens, Lancashire.

Engines for Boats.—Let R. T. write to Mr. Parker, of Lilford road, Camberwell. He has lately tried a boat of about the same dimensions, and very successful he was.

Moulder's Guide.—"A Moulder" can get the following works from Messrs. Spon, 16, Bucklersbury, London price 5s post free, published 1864, viz., "Overman's Moulder's and Founder's Guide, a Treatise on Moulding and Founding in green sand, dry sand, loam, and cement." Moulding of Machine frames, Mill gear, Hollow ware, Ornaments, Trinkets, Bells, Statues; Description of Moulds for Iron, Bronze, Brass, and other Metals, with receipts for Alloy, Bronze, Varnish, and Colours. Another Moulder's Guide can be had from Trubner, 60, Paternoster-row, price 4s. 6d.—George Dutton.

Bastard Wheel is a term usually restricted to a bevel wheel, which is not entirely of the same pitch as the wheel it works into. The accompanying rough sketch



will explain my meaning:—A B, a pair of bevels working at right angles; C a bastard wheel working into A of the same number of teeth as B. By comparing B and C it will be seen that, although they are the same diameter and pitch at the back, yet at the face C is larger in diameter than B, and consequently the pitch of C will be coarser at the face than A. A bastard wheel is usually made to save the trouble of making two wheels.—J.C.S.

Pitch of Wheels.—I fear Wm. Gale will find it difficult to arrive at what he wants by Joseph Stanley's arithmetic. Mr. Stanley says if the number of cogs be multiplied by the pitch, the product will be the circumference, which product multiplied by 7 and divided by 22, will give the diameter; but a little consideration will show that the result is erroneous, and the greater the pitch, the more the error, because the pitch and number of cogs form a polygon of as many sides as there are cogs. Now take a simple case: Suppose a wheel of 6 cogs, and 6 in. pitch, then according to Mr. Stanley, and C. A T., the circumference would be 36 in., but according to Euclid it would be 37·6992. If I understand Mr. Gale, what he wants to know is where to circumscribe the pitch line on a wheel: if so, half the height, (or, as some call it length,) of the cog, less by what is required for freedom to work is the proper plan.—James Sharpe.

Chuck.—I am sorry to find that T. E. Merritt misunderstands my illustration of the faulty part of his chuck. Instead of expanding the hinged jaws ¼ of an inch each, as I show in illustration, making from ½ inch to ¾ inch, say: suppose the chuck to be made for 1-16 h drill, expand the jaws and put in a 3 16th or ⅛ drill, measuring the shanks to increase or diminish according to size of drill. I contend the nut will choke upon the jaws, unless, instead of the nut being coned to the same angle as the jaws, it be rounded which will then adapt itself as the jaws are expanded, trusting this explanation sufficient, perhaps some other subscriber will give an opinion upon this subject.—H. Gray.

By alloying a metal with a non-metallic substance the conductive power of the metal is altered as shown in the case of the combination of iron with carbon, thus—forged iron is represented by 436, steel 397, and cast iron 359, silver being taken as 1,000.

The Government proposes to appropriate the vacant land at South Kensington, one portion to the reception of certain collections from the British Museum, the other to patents.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

All letters intended for the Editor should be addressed to 75, Fleet-street.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

A. Law.—You can purchase the disenfecting fluid of any chemist in a moderate way of business.

George Dutton.—We have searched the last six numbers of the work you name without success. If you can furnish us with the exact date we shall perhaps be able to meet your wishes.

Slide Valve.—Received too late for engraving diagram this week.

A well Satisfied Subscriber from the beginning.—Received with thanks.

J. E P. W.—See article in next number.

Jas. Connor.—We shall be glad to accept your communication on trains of wheels.

Carbon.—We have not the correct address, but should think that the Post-office authorities ought to have found the firm through your direction. Try the Post office Directory. Thanks for your hint respecting the shops; we will see that a better supply is forwarded.

Glasgow.—If you wish for a good second-hand one you had better advertise; you can then select for yourself.

Charles Waterhouse.—Directions have been given in the last two or three numbers.

J. Stone.—Mr. Page is one of our chief engineers. We cannot recommend you any special book, but you will find constant reference to works in hand in the pages of the *Builder*, *Building News*, and *Practical Mechanics Journal*.

Bickerdike.—*Gentleman's Magazine*, Bradbury and Evans, Whitefriars, price 2s 6d. monthly.

Frederick Johnston.—Not applicable to all the purposes of the steam engine. It is but as yet in its infancy.

J. Davidson.—Received, and under consideration.

W. H. M.—Such a glue has been tried but will not work.

J. T. M.—In our opinion steel is decidedly the best; the Americans also give it the preference.

X. x Y.—Can obtain such a work of Lockwood, Paternoster-row.

W. G. P. (Dublin.)—Your boiler would require to be about 18 inches in height—of copper, brazed, with about a dozen brass tubes under a foot in length, and not more than ¾in. diameter. Your boiler should be of, say 11 in. diameter, the internal fire-box three inches less outside diameter, and seven inches from grate to crown. A smoke-box of sheet iron, domed, can be fitted on the top of the boiler, with a funnel half as high again as the boiler, of not less than two inches diameter; into this turn your waste steam. For fuel, we find for such boilers that small coke is most generally used. You might be able to purchase such at second-hand. Why not speculate a few shillings?

Jas. Mather.—We should advise you to keep to the model engines; they generally find a ready market.

Arnold Henry.—You can obtain it through any respectable optician.

David Copperfield.—Thanks for the suggestion. It is our wish to keep our advertisements as close as possible so as not to interfere with the general matter.

L. M.—Jas. Muir.—A Glasgow Subscriber.—J. B. Johns, and others, are also answered by the above.

Thos. T. B.—So much will depend on circumstances that we can scarcely venture an opinion. Perhaps £100.

B. P. (Dublin).—Was snapt up in no time, but there may yet happen another chance. All advertised in the Exchange have been, we believe, exchanged to satisfaction.

A Manx Man.—We can judge of nothing unless you forward us a drawing. Such a contrivance is really wanted; send a sketch and you shall have our opinion.

Alfred P. Wire.—Thanks.

J. M.—You must first state the work you want to turn out of your mill.

Anthracite.—Only, at present, from a manufacturing chemist. If there is none in your town, a dispensing chemist could tell you the nearest, and to him you could write. Respecting the technicalities spoken of, it is simply impossible to avoid them. You are aware there is no royal road to knowledge, and, giving the quantity of matter we do weekly, it is impossible for us to go on repeating—which we should have to do to comply with your request. The queries, as you are aware, are answered by working men, and really we have so many thanks sent us for the answers, both there and otherwise, that we are inclined to fancy you are somewhat mistaken. We say this without any intention of offending. Respecting the technical terms, the use of them in an order to a chemist will be sufficient; you may prove this on trial very quickly.

J. B (Stroud).—You would require to do it through an advertising agent in London—send a specimen advertisement, and a request to know his charges for inserting it in two Belgic and French papers, once a week, for a month, to W. Thomas, 26, Brydges Street, Covent Garden. You will find the wages in most cases about the same—allowing for differences in prices of various things. There is some capital practice to be had in both countries, just now.

Vertical Saw.—We have no doubt a few shillings would be well spent in our advertising columns. Numbers of our readers we are certain would be able to suit you to a T.

Steam Jet.—The entry into the box of the pipes should be as small as possible, but the difference would be almost inappreciable.

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J. W. R. (NEWCASTLE-ON-TYNE).—A correspondent in our last, as you will have noticed, has given an opinion adverse to yours. The scheme is patented; we have elsewhere inserted part of your query.

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

PROGRESS OF INVENTION.

MOTIVE-POWER ENGINES.—An invention has been provisionally specified by M. Gerin, of Paris, which relates to a means of utilising the expansion of gases and vapours at all pressures and temperatures, by combining the rectilinear to and fro motion of several pistons united together for the production of rotary motion therefrom, and so as to obtain motive-power acting constantly in the same circular direction without the aid of intermediate parts, which absorb a large part of the motive-power through friction or otherwise.

FIREBRICKS.—In the course of a discussion at the Academy of Sciences on the 5th inst., on a paper by Captain Caron, it was stated that the firebricks used in France for metallurgical purposes are brought from this country, and that they are sold at one franc each. It was suggested by M. Boussingault that magnesia bricks would not be more expensive, and it would appear that there is an advantage in using this substance. In this country crude fireclay is worth from five to ten shillings or even a guinea per ton.

MANUFACTURE OF STEEL AND HOMOGENEOUS IRON.—The essence of the invention of Mr. Robert Mushet, of Cheltenham, consists in refining or purifying melted pneumatised pig-iron or cast-iron by the joint action of the pneumatic blast, and that of successive eliminations, by means of the said pneumatic blast, of the carbon and manganese, and of the carbon, manganese, and titanium, of repeated doses of spiegeleisen, or of spiegeleisen, and titanic pig-metal, jointly added to melted pneumatised decarbonised pig-iron or cast-iron.

KEYING BRICKS.—By the simple and not novel invention of moulding common bricks with dovetailed grooves in various ways, by means of which they can be more firmly cemented together, a decided improvement in the construction of brick walls appears to have been secured, at little or no additional cost, and, indeed, to the saving of the cost of iron bonding. The patentee is Mr. T. L. Jowitt, of Swansea, architect. His specification includes the manufacture in any plastic material. The various applications of such an invention will be very obvious to our professional readers; but we may instance a secondary or incidental one: thus, by inserting pieces of wood, flush with the plaster, in the grooves before setting, joiners' work, or any ornamental work requiring nailing, can be easily fixed. The bricks can all be made and used as common bricks, and architects and engineers can specify them without breaking existing contracts.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal

APPLICATIONS FOR LETTERS PATENT.

442. Alfred Stoddart, Brook-street, Kennington-road, improvements in apparatus to be employed in illusory exhibitions.
444. Montague Richard Leverson, 66, Bishopsgate-street, London, improvements in the manufacture of gas suitable to be used for illumination or for obtaining heat or motive power.—A communication.
447. Samuel Marland, Clayton, near Manchester, improvements in obtaining and applying artificial heat, and in apparatus employed therein.
449. Charles Gilpin, Esq., 10, Bedford-square, improvements in the production of copper or other metallic plates, for the purpose of printing therefrom.
453. Samuel William Kelly, Cardiff, improvements in the manufacture of rails, bars, and girders.
456. John Ogden, Leeds, improved means or apparatus for the extinguishing of fires in steam vessels, mills, and other buildings in which steam is used.
457. William Robert Lake, 8, Southampton-buildings, Chancery-lane, improvements in vices.
458. Frederick Ransome, Southwark-bridge, improvements in the manufacture of building blocks of artificial stone.
459. William Cotter, Hackney-road, improvements in heating apparatus used for melting glue, and for heating wood and irons.
466. Henry Ernest Baron de Gablenz, Berlin, an improved system of submarine telegraphic cable for the transmission of electric despatches.
467. Robert Smith, Paper staining Works, Hyde-road, Manchester, certain improvements in printing designs on paper for hangings, coverings, sun blinds, and other purposes.
469. Michael Henry, 68, Fleet-street, improvements in photography, and in the process of producing printing surfaces and other like surfaces by the aid of photographic agency.—A communication.
473. Henry Edward Newton, 66, Chancery-lane, improvements in optical instruments.—A communication.
479. Thomas Adams, 5, Duke street, Adelphi, improvements and applicable to slide valves, pistons, and glands.
480. Donald Nicoll, Oaklands Hall, Kilburn, improvements in the construction of electric telegraph conductors, and in the method of preparing and laying the same, also in the machinery or apparatus to be employed therein.
489. Thomas Charles Boutet, Lewisham-road, Greenwich, a new system of bridge, with a means of constructing them of a single reach or span from one bank to the other, that is, without piles between the abutments.
502. Adolphus Henry Linnington, 58, Fenchurch-street, improvements in rudders and steering apparatus.—A communication.
503. James Heywood Whitehead, Saddleworth, York, improvements in apparatus for heating the feed water for steam boilers.
508. Henry Willis, Worcester, improvements in mechanism for converting rotary motion in reciprocating motion.
513. Joshua Kidd, Battersea Rise, improvements in carburetting low pressure superheated steam, air, or coal gas for lighting and heating purposes, for generating steam or hydro-carbon vapour, and in apparatus employed therein.

LIST OF SPECIFICATIONS, &c.

PUBLISHED DURING THE WEEK ENDING 17TH FEBRUARY, 1866.

650. Blast-heating stoves for furnaces, R. Howson—4d.
691. Refrigerating or freezing liquids, J. Henderson—1s. 4d.
703. Fibrous material for manfng paper, J. Webb—4d.
704. Regulating lamp shades or reflectors, W. Clark—8d.
705. Preparing colouring matters, F. Wise—4d.
706. Facilitating dental operations, W. D. Napier—4d.
707. Supplying measured quantities of water, &c., R. G. Rattray—4d.
708. Breech-loading fire-arms and cartridges, F. A. Braendlin—1s. 2d.
709. Levers for railway switches and signals, J. Deas—10d.
710. Heels for boots and shoes, G. Evans—8d.
711. Breech-loading fire-arms, R. A. Brooman—8d.
712. Photography, R. A. Brooman—4d.
713. Protecting telegraphic instruments, A. Bertsch—4d.
714. Safes, E. D. Hodgson—1s. 4d.
715. Drying and sorting coals, ores, &c, F. H. Warlich—4d.
716. Lace or net, J. Wilkie—4d.
717. Vaporising hydro-carbon liquids, G. T. Bousfield—1s. 4d.
718. Bleaching and dyeing yarn, L. Gantert—10d.
719. Securing uniform temperatures, A. V. Newton—4d.
720. Trimming, J. P. Booth—4d.
721. Colour printing, I. Baggs—4d.
722. Tuyeres, N. N. Solly—4d.
723. Electric piles, &c., W. Clark—8d.
724. Smoke vents or chimneys, T. Kennedy—4d.
725. Stocktings, &c., H. Owen—4d.
726. Keyless watches, H. Chevob—8d.
727. Distilling oils from coals, &c., W. E. Newton—1s.
728. Safes, E. Loysel—4d.
729. Obtaining sulphurous acid, A. P. Price—4d.
730. Cooling animal and other charcoal, J. F. Brinjes—10d.
731. Gas engines, H. Smith—4d.
732. Treating and purifying oils and fats, C. Morfit—4d.
733. Mail and despatch bags, &c., G. T. Bousfield—4d.
734. Preserving timber, S. B Boulton—1s. 6d.
735. Threshing machinery, M. Meisel—4d.
736. Rolling and shaping metals, J. Ramsbottom—1s. 10d.
737. Mining coal, &c., J. Farrar, and E. Booth—10d.
738. Railways, W. Loeder—10d.
739. Agricultural implements, J. Seaman—8d.
740. Working railway signals, R. Bell—10d.
741. Musical instruments, W. Brookes—10d.
742. Threshing, dressing, and grinding grain, &c., J. Marshall—4d.
743. Steam generators and evaporators, A. V. Newton—6d.
744. Differential wheel gearing, J. Standfield—4d.
745. Railway breaks, H. A. Bonneville—8d.
746. Pencil shield, C. A. Wheeler—4d.
747. Tempering knives, tools, &c, H. Wethered—4d.
748. Steam engines, B. Lawrence—8d.
749. Telegraph posts, G. Dibley, and F. Braby—10d.
750. Looms, J. Bullough—1s. 6d.
751. Combined steam engine and pump, J. Goodfellow—4d.
752. Treating waste canvas, &c., W. M. Williams—4d.
753. Lamps and lanterns, A. V. Newton—1s.
754. Cocks or valves, W. Roberts—4d.
755. Driving smiths' fans, J. Cookson—4d.
756. Lap machines, T. Ogden—4d.
757. Weighing machines, J. McConnell—10d.
758. Clothing, G. Ralston—8d.
759. Weft stop motions for looms, B. Pilling—10d.
760. Peeling almonds, J. H. Wathew—4d.
761. Drawing off liquids from casks, J. Walls—10d.
762. Mordanting cloth and yarns, T. Kenyon, jun.—4d.
763. Attaching buttons to fabrics, F. Wise—1s.
764. Brushes or brooms, J. Vero—4d.
765. Preparing hyposulphite of lime, J. C. Stevenson—4d.
766. Sewing machines, O. Robinson—4d.
767. Brick and tile machines, C. W. Spark, T. S. Cross, W. Adkins—4d.
768. Floor cloths, J. H. Kidd, and J. C. Mather—10d.
769. Paper collars, S. S. Gray—1s.
770. Mouth-piece for cigars, T. Oliver, and J. Musto—4d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

PROPERTY RECORD.

SALES AT GARRAWAY'S.

By Mr. NEWBON.

Leasehold residence, being No. 6, Compton-terrace, Islington, let at £90 per annum, term 95 years from 1821, at £10 per annum—sold for £1,300.

Leasehold three residences, being Nos. 30, 35, and 36, Richmond-crescent, Richmond-road, Barnsbury, producing £158 per annum, term 85 years unexpired, at £8 each per annum—£1,595.

Leasehold house, being No. 177, Euston-road, let at £54 per annum, term 42 years unexpired, at £14 per annum—£505.

Leasehold residence, being No. 63, Hemingford-road, Barnsbury, let at £36 per annum, term 98 years from 1844, at £6 per annum—£425.

Leasehold two houses, being Nos. 2 and 4, Caledonia-street, King's-cross, also two cottages in the rear, producing £96 4s. per annum, term 38 years unexpired, at £8 each per annum—£610.

Leasehold house, being No. 43, New Church-street, Bermondsey, let at £24 per annum, term 24 years unexpired, at £2 per annum—£150.

MEETINGS FOR THE WEEK.

TUESDAY.—Medical and Chirurgical, 8½. Civil Engineers, 8. Mr. Edwin Clark, "The hydraulic lift graving dock." Zoological 8½. Ethnological, 8. 1. Sir John Lubbock, Bart., and Mr. Frederick Lubbock, "On the true assignation of the bronze weapons, &c." 2. Mr. John Crawfurd, "On the origin and history of written languages" Royal Inst., 3. Professor Frankland, F.R.S., "On the non-metallic elements."

WEDNESDAY.—Society of Arts, 8. Report by the Secretary, "On the results of the Art-Workmanship competition, from its commencement."

THURSDAY.—Royal, 8½. Antiquaries, 8½. Linnæan, 8. Mr. Herbert Spencer, "On circulation and the formation of wood in plants." Chemical, 8. 1. Mr. C. R. Wright, "Chemical action of sunlight." 2. Prof. Church, "New Cornish minerals." Royal Society Club, 6. Artists and Amateurs, 8. Royal Inst., 3. Professor Frankland, F.R.S. "On the non-metallic elements."

FRIDAY.—Royal Inst., 8. Mr. G. Scharf, "On Portraiture." Philological, 8. Archæological Inst., 4.

SAT.—Royal Inst., 3. Rev. G. Henslow, "On systematic and structural botany."

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Excavation and building a brick gasholder tank, 104 ft. in diameter, and 33 ft. deep, with hydraulic well, and counterforts complete for the Corporation of Stockport. Particulars of Mr. Jacques, engineer and manager, Court-house, Stockport.

Supply of an iron wharf crane, warranted to lift five tons as a working average, to the Southampton Harbour and Pier Board. Particulars at the office of the Surveyor, at his office, Town Quay.

The Town Council of the Borough of Dorchester invite tenders for the following works:—Contract No. 1.—For supplying and erecting a compound or condensing Steam Engine, with a Boiler and Pump, capable of lifting 30,000 gallons of water per hour from a well to a height of 150 ft. Contract No. 2.—For supplying about 500 fs. of 12 in. cast iron water pipes. Particulars from Jeremiah Jowett, Esq., C. E., at the Guildhall, Dorchester.

Erection of a Lighthouse Lantern, and for other ironwork for the Flatholm Lighthouse, near Cardiff. Particulars of P. H. Berthon, Esq., Trinity House, London, E.C.

Tenders for a Telescope gasholder, the inner lift to be 100 ft. and the outer 102 ft. in diameter, and 32 ft. deep, with the requisite guides, rollers, columns, and girders, complete. Particulars of Mr. Jacques, engineer and manager, Court House, Stockport.

Supply of broken granite to the Tottenham Local Board of Health. Particulars of William Heath, Esq., Board office, High Cross, Tottenham.

The Commissioners of her Majesty's Works and Public Buildings are prepared to receive tenders for the ordinary works and repairs to public buildings. Particulars at the Office of Works, Whitehall.

TENDERS SENT IN FOR BUILDING WORKS.

For new warehouses, Pudding Lane, City. Mr. Robert Edis, 4, Osnaburgh Terrace, Regent's Park, architect:—Manley and Rogers, £1,894; Sharpington and Cole, £1 597 Brown and Robinson, £1,410; King and Sons, £1,340; Conder, £1,227.

Rebuilding part of house No. 16, Princes Street, Mile End, New Town. Mr. G. H. Simmonds, architect:—Read and Son, £235; Cuthwaite, £225; Wood Brothers, £214; Langmead, £190; Tolley, £187.

For four houses and a beerhouse at Bowles Dale, Chatham for W. Smith, Esq. F. H. Andrews, architect, Rochester, —Sampson, £1,740; Kemp, £1,700; Naylor and Son: £1,647; Collins and Son (accepted), £1,422 18s. 1d.

Alterations and additions at No. 5, Surrey Place, Newington Butts Mr. J. Turk Lacey, architect:—Messrs Southall and Watson, £210; Mr. M. Dentson, £182 2s. Mr. J. W. Jacob, £113 15s.

For the restoration of Billingshurst Church, Sussex. Mr. Robert Edis, architect:—Waddy and Sons (including new seats, &c), (accepted), £1,302.

LONDON COAL EXCHANGE.

PRICES OF COAL PER TON.

Cowpen Hartley, 16s.; Hastings Hartley, 16s.; Holywell Main, 17s.; Tanfield Moor Butes, 15s.; Eden Main, 16s. 6d.; Shaw's Hartley, 18s. 6d.; Walls End Hawton, 15s. 9d.; Walls End Braddyll's Hetton, 17s.; Walls End Haswell, 18s.; Walls End Hetton, 18s. Walls End Hetton Lyons, 15s. 9d.; Walls End South Hetton, 17s. 9d.; Walls End Tunstall, 15s. 9d.; Walls End Caradoc, 17s. 9d.; Walls End Hartlepool, 17s. 9d.; Walls End Kelloe, 17s.; Walls End East Hartlepool, 17s. 9d.; Walls End Hartlepool, 17s.; Walls End Tees, 17s. 6d.; Walls End North Staffordshire, 17s.

Ships at market, 75; sold 44; unsold, 31; at sea, 25.

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LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
Copper.							
British—cake and tile	per ton	95	0	0	96	0	0
Sheet	do	99	0	0	101	0	0
Iron.							
Pig in Scotland	per ton.	3	10	6 cash.			
Welsh Bars, in London	do	7	15	0	0	0	0
Wales	do	6	15	0	7	0	0
Staffordshire	do	8	10	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
Lead.							
Pig, Foreign	per ton	20	10	0	20	15	0
Red or minium	do	22	10	0		—	
Quicksilver	per bottle	7	15	0	7	17	6
Steel.							
Swedish faggot	per ton	0	0	0		—	
,, Kegs	do	15	10	0	16	0	0
Tin.							
English Blocks	per cwt	4	12	0		—	
Banca	do	4	8	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.		s.	£	s.
Teak	11	10	12	10	Canada, 2nd qual.	12	10	14	0
Quebec, red pn.	3	5	4	15	St. Petersburg yel.	10	10	12	0
yellow pine	2	15	3	10	Finland	8	0	10	0
Memel	0	0	0	0	Memel	0	0	0	0
elm	3	10	5	0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Dantzic oak	3	10	6	0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	6
fir	2	5	3	10	Staves, per standard M.				
Memel fir	3	0	3	10	Quebec, pipe	80	0	85	0
Riga	3	5	3	10	puncheon	20	0	25	0
Swedish	2	0	2	10	Baltic crown pipe	170	0	190	0
Masts, Quebec, red. pine	6	10	8	10					
yellow pine	5	0	6	0					
red pine	0	0	0	0					
Lathwood, Dantzic	5	10	6	10					
St. Peter's	7	0	8	0					
Yellow Pine, per reduced C.									
Canada, 1st qual.	17	0	19	10					

MISCELLANEOUS.

	£	s.	£	s.		s.	£	s.
Pumice Stone per ton	5	0	8	0	Olive, Gallipoli	56	10	0	0
OILS, &c.					Cocoanut, Cochin	51	0	52	0
Seal, pale pr. tun	50	0	0	0	Palm, fine	41	0	0	0
Sperm body	120	0	0	0	Linseed	39	0	0	0
Cod	50	0	0	0	Rapeseed, Eng. pale	53	0		0
Whale, 8th Sea pale	48	0	50	0	Cotton, seed	32	10	39	0

IMPORTANT TO ADVERTISERS.

The Proprietor of the "English Mechanic" gives insertion to Workmen's Advertisements, "Situations Wanted," at the charge of One Shilling each Advertisement, if not exceeding Twenty Words. Every additional Eight Words Fourpence.

Postage stamps received from advertisers in the country.

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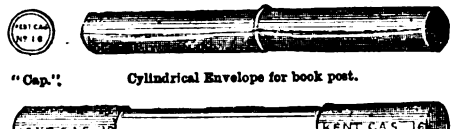

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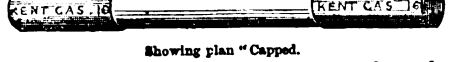

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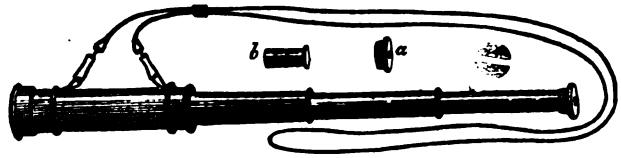

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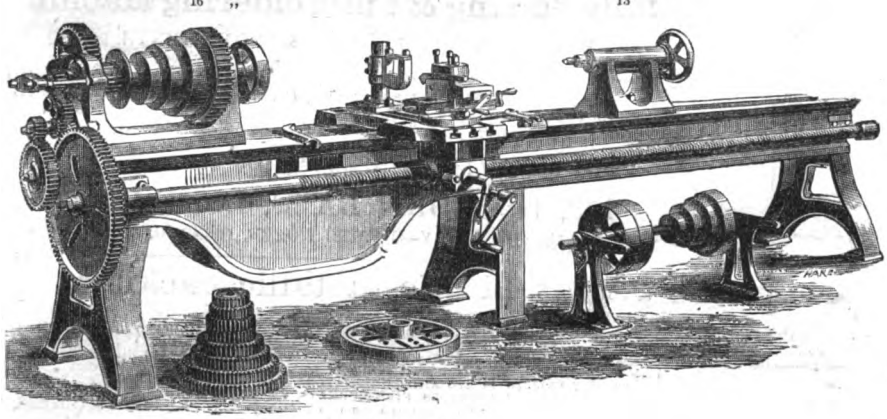

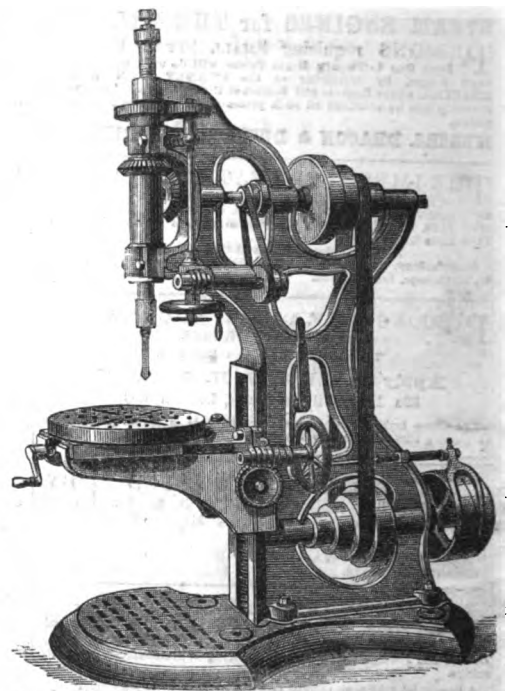

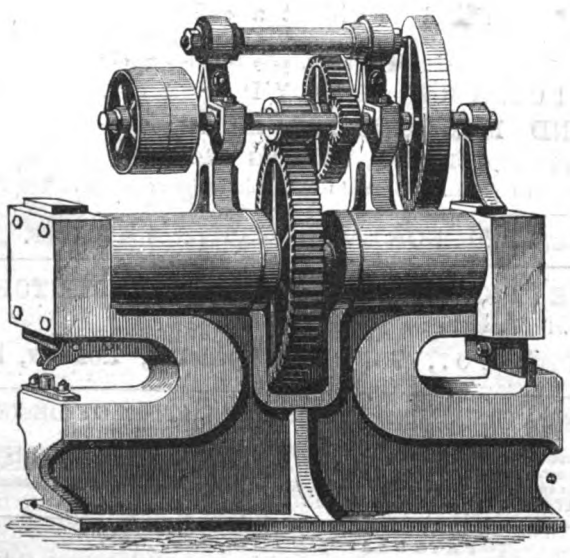

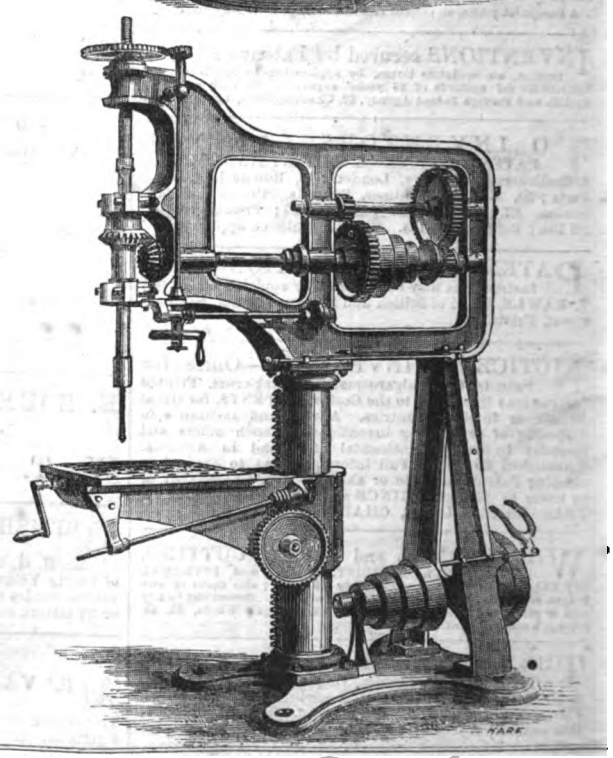

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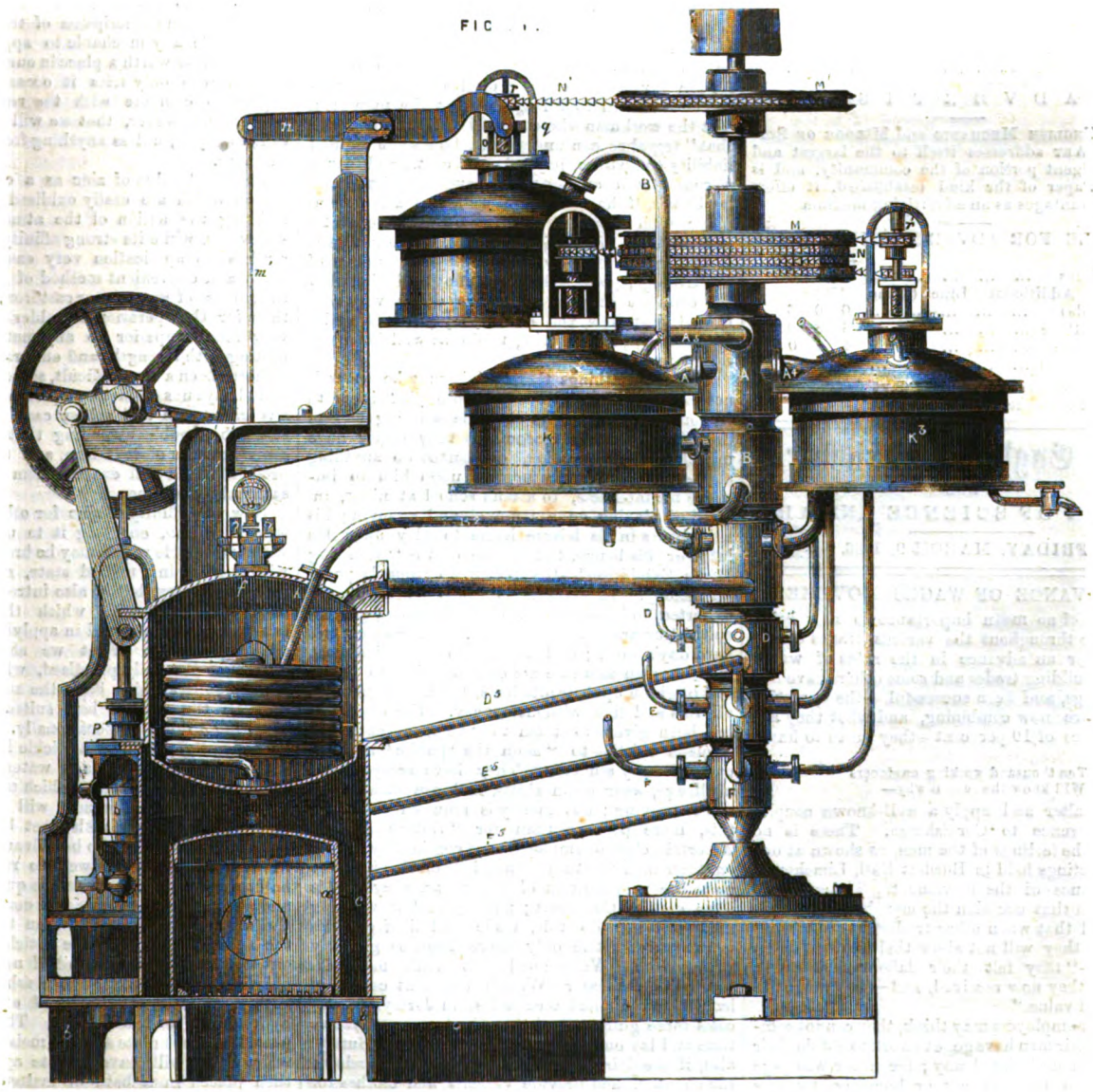
VOL. II.—No. 50.] FRIDAY, MARCH 9, 1866. [PRICE TWOPENCE.



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to slightly alter and apply a well-known couplet having reference to Cornishmen. There is no mistaking the feelings of the men, as shown at one of their meetings held in Burdett Hall, Limehouse, in furtherance of the movement. Through the chairman on that occasion the men have emphatically stated that when other trades are obtaining an advance they will not allow theirs to remain an exception—"they felt their labour was worth more than they now received, and—they meant to have its full value."

Whatever employers may think, they cannot complain that their men have gone to work to obtain their object in an underhand way; for never was gage thrown down more openly or honestly, by any more impressed with the justice of their cause or more fully determined to stand by it to the very end.

That the engineering trade generally is in a most flourishing condition we think few will gainsay. We have nothing to do here with speculators, bubble-men, or those who overrate their own powers and fancy they will do as masters when they seem to have been designed to be but good workmen; we refer only to those who have conducted and are conducting in a business-like manner their several departments; and we say that all such are prosperous, and have much more work on their hands than they can well get through. It is such men as these will have to settle the question as to whether the advance asked will be given, and we have no doubt that, as thorough men of business, they are quietly conning the affair over now.

On the face of it 10 per cent. looks a large advance—but what is it to a workman? Simply, it will pay only for that increase in his rent which has taken place so recently, and for the supply of those former luxuries of books and instruments which a true mechanic now looks upon as necessaries; or, if he prefers to live in cleanliness and health on the outskirts of the town, it will just pay for his "workmen's train" tickets, and those other things mentioned. Looked at in any light the whole question just resolves itself into this:—Is the workman capable of paying the enhanced price of the various necessities of life without a corresponding increase of wages? We do not think he is justified in trying to do so—until he finds he cannot do otherwise. As we have on previous occasions stated, the workman has no means of knowing how his employer is paid for the investment of his capital and his genius—but it is known to a fraction what the man gets. Yet the workman who can read and put "this and that" together can understand how some limited liability companies pay 20 per cent., and carry a round sum over, against eventualities: and he knows, if he can figure well, that a large employer with brains would turn up his nose at 20 per cent. on *his* business. Still, no *correct* estimate can be formed of an employer's, or even of the average, gains. But it cannot be denied that the class we have in view are doing very well indeed, just now, and have every prospect, under Providence, of continuing to do as well for many a year to come.

One or two things there are it may be as well not to forget here. Those whose *forte* it is to patronise and pat on the back the working man—this for the simple reason that they either have mistaken their vocation, or cannot do anything else,—are continually urging upon him to improve his intellects, to attend school at night, instead of playing on a trumpet and annoying his neighbours in his leisure hours to play upon his lathe or his bench, to the tune of the "Working Man's Exhibition"—that recently extremely popular melody. In short, he is asked generally, and exhorted, to be very good, cleanly, decent, genius-cultivating and industrious at home after a long and hard day's work; and it is not to be denied that working men as a rule are endeavouring to better and brighten up their intellects, but they cannot do all this and live without money. The challenge has been given to them to "be men, and wear a clean shirt"—to "shun the 'public' and become literary students. They have accepted the challenge, wear clean shirts, and are steady and self-improving; but money is required to do all this, more perhaps than for "riotous living." A certain class of employers are continually urging on their men to study "applied mechanics"—to go to the very bottom of things, as, they *say*, is done on the Continent; adding that if working men will not do this, trade will fly from this country, and settle only where it can be properly attended to. Very good—but still, money is wanted. Professor Willis's excellent course of lectures on applied mechanics, in Jermyn-street, costs three guineas, and then the learner must lose time and lay out money in experimenting. Surely, also, if the doing of this is to keep the trade in the country, and provide victuals and clothes for the worker and his family, it is to do the same for the worker's employer. If so, then the labourer is worth an increase in his hiring money.

There is every reason why an increase should be made in the rate of wages; will the market prices of finished goods allow of expansion, or can the employer afford to do for a little while with less profit? Surely if the workman is learning at home at night, he is day by day becoming more valuable to his employer, so that any reduction in profits must be but temporary. The thing looks a perfect square in theory. Suppose it be carried into practice?

However the matter may terminate, we sincerely trust there will be no strike. We have a horror of such—of the misery attending and following them: and if there be no mistake, and this be the vaunted 19th century, then surely the thing can be managed without drawing fires, closing doors, and famishing families.

GALVANIZING.

AS correspondents are continually seeking information about the art of galvanizing, although it has been treated on in previous numbers, and as the regular trade are very close on the subject, refusing as a general rule admission to their works, or any information about the practical working of their arts; and as, moreover, the practice of the art is attended with considerable difficulty when not fully understood or practised day by day; while the application of it would very often be of considerable value to the practical mechanic for special purposes—some description of the process such as will enable any mechanic to apply it on a small scale must be worth a place in our columns, though no one who only tries it occasionally can ever expect to compete with the regular trade. We may state, however, that we will not again return to the subject, unless anything fresh in the process turns up.

The great value of zinc as a coating for other metals which are easily oxidised is its power of resisting the action of the atmosphere and also salt water, while its strong affinity for other metals renders its application very easy and affords a ready and convenient method of either protecting the surface of wrought or cast iron, or of preparing them for the operation of soldering in a manner very much superior to any method of tinning; uniting both strength and endurance in what has hitherto been a very difficult, sometimes impossible, and always unsatisfactory operation. Anyone who has tried to tin and solder cast iron will understand the trouble attending that operation, with some qualities of cast iron, and the value of any process which will enable them to do this in a satisfactory manner.

Now this affinity of zinc for other metals, more especially iron, enabling it to unite very readily with any article which may be brought into contact with it when in a melted state, renders its application very easy, but it also introduces one of the chief difficulties with which the inexperienced operator has to contend in applying it, as will be shown hereafter. First we shall describe the process as generally practised, without forgetting the difficulties which beset the amateur, and then describe the method best suited for those only requiring to use it occasionally. In the process as generally practised a pickle is first made up composed of three parts of water and one part of sulphuric acid by weight, which must be kept in a trough on which the acid will have no action. A wood trough lined with sheet lead will answer very well. The article to be galvanized is immersed in this pickle and allowed to remain for about half an hour (or longer, as the quality of the iron and strength of the pickle will determine). When the skin of the iron has been thus cleansed by the action of the acid, the article is to be taken out and its surface scraped, if necessary, with an old file. It is then to be washed and painted with a solution composed of equal portions of hydrochloric acid and water. The article is then placed on a hot plate and the moisture evaporated; when dry it will have a white appearance. It is then placed in a bath of melted zinc (which is kept covered with fused sal ammoniac, or with a mixture of sal ammoniac and sand, which is cheaper), and allowed to remain till it has acquired the same

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temperature as the zinc. It is then lifted out and allowed to drain, when the surplus metal will run off and leave the article quite clean if it has been properly galvanized. If not quite clean and smooth it must be done again. When cold it is washed with a solution of soda, and dried. The difficulty of this operation consists in keeping the melted zinc in a fit and proper state for working. If melted in a cast iron pot over a fire with a flue the degree of heat is so difficult to control, and the affinity of zinc for cast iron so great that in a very short time the whole of the zinc will be rendered unfit for use by the combination of cast iron with it. If 5 per cent. of cast iron be held in suspension by the zinc the composition is quite unfit for galvanizing, is difficult to melt, and remains in a sluggish and pasty condition in the pot. This of course takes place under any condition, as the articles galvanized will always deposit a certain amount of iron, but the regular trade reduce the waste and inconvenience from this source to the minimum by using a fire without a flue, melting the zinc in a wrought iron pot or rather bath. They melt the zinc in large quantities at the lowest possible heat, being thereby enabled to retain the covering of muriate of ammonia on the top of the melted zinc, which would otherwise fly off if the heat were allowed to rise, as well as retard the depositing of iron and wasting of the iron bath which are so very objectionable; but with the best possible care, the bottoms, as they are technically termed, must be occasionally lifted out and fresh zinc added to the bath, as a certain amount of iron is constantly being deposited from the articles which are immersed in the zinc. If the temperature of the zinc is kept low and not disturbed much, this deposit will fall to the bottom, where it settles in a pasty condition and can be lifted out from time to time as required. The construction and management of these zinc baths is peculiar. The bath itself is a large wrought iron tank of sufficient capacity to hold metal enough not to be chilled when the article to be galvanized is put in; it is set on brickwork, there being no flue and no fire below the bath, but oven-burnt coke is packed round the bath and retained in its place by brick walls in which there are openings fitted with dampers to regulate the intensity of the heat, which requires careful attention on the part of the workman; the damper is generally just a few loose bricks in different parts of the wall which may be either taken out or put in as required. When once one of these baths is started it is usual to work it right on both night and day till it is completely worn out, as it will not pay to stop and empty the bath. Many of these baths are of immense size, holding 20 to 30 tons of zinc, so that the stopping or starting of one is a matter of some importance. The bottoms or refuse zinc in combination with iron is generally disposed of for what it will fetch, for some other purpose, such as the manufacture of disinfecting fluid, as it will not pay to purify it unless coals can be had for about 3s. per ton. As this is only possible in the coal district, Alston Moor, in the neighbourhood of Durham, is probably the only district in England where the distillation of zinc is carried on. Silesian zinc is considered the best for galvanizing, the cakes of which, when broken up, present a very beautiful crystalline appearance. For those who only occasionally require to galvanise a plumbago crucible is to be used for melting the zinc. As there is no action between the plumbago and zinc, as a consequence no deposit takes place but from the articles which are being galvanised. This is a very important matter to the amateur, as he saves both his zinc and his bath, besides obviating the inconvenience and trouble which metal deteriorated by the presence of iron from the pot in which it is melted entails. When galvanizing is used for special purposes by the mechanic it will be found to facilitate the operation very much if the skin of the iron is first removed by turning or otherwise, as this will save the pickling, which is a disagreeable and costly operation when only required occasionally. Whenever it is possible to prepare a clean metallic skin the following method should be pursued:—Heat the article to between 300° and 400° Fah., then dip it in a solution composed of 1lb. of zinc cuttings in as much hydrochloric acid as will dissolve it, to which add 1lb of sal ammoniac bruised fine, allow the solution to settle and then strain; the article is to be passed quickly through the solution; when withdrawn, the heat of the article will evaporate the moisture and leave a deposit of the salt on the surface of the iron. The moisture should all be evaporated, as otherwise there might be an explosion in the zinc. When dry it is to be immersed in the zinc, which is melted as follows:—A few bricks are laid down and an old moulding-box placed on the top of them, inside of which the plumbago crucible is placed and the coke packed round the crucible, not below it. Of course, this arrangement may be varied, but this answers very well. The heat is to be kept as low as possible so as just to keep the zinc liquid, and the top covered with muriate of ammonia. When the articles are ready they are to be taken out, drained, and washed as before. If properly attended to the crucible will last a very long time, having no deleterious effect on the zinc, the deposit formed being due only to the articles galvanized. A crucible of the Battersea Company's make will last for six months in constant use for this purpose.

Cast iron which has been galvanized can be very readily soldered afterwards to any other metal, by means of soft solder, and in foundries where there is much coreing in the work, galvanizing the chaplets which are to support the cores will be found of considerable value, as the metal does not fly off chaplets that have been galvanised. The refuse metals may be used as an anti-frictional lining for bearings exposed to constant grinding by the presence of sand, and will be found to answer very well indeed, wearing well and retaining a smooth surface As the material is very cheap it might be worth a fair trial against a more expensive material, and if found to answer generally, might utilise a waste material or nearly so, the production of which is already considerable. J. D.

MOTIVE POWER FROM AMMONIACAL GAS.—I.

(Illustrated on front page)

RECENTLY a patent was secured by Mr. Brooman, of Fleet-street, for improvements in machinery for obtaining motive power from ammoniacal gas, the subject of a communication from M. Flandrin, of Paris. The machinery, the subject of the patent, is composed of—1. Two generators; 2. Receiver; 3. Four condensers; 4. Distributing boxes; 5. Suction and force pump; 6. Motive power cylinder and flywheel; 7. Apparatus for expelling air from machine. It may be mentioned here that the patentee prefers to make the apparatus of wrought or cast iron; copper should be avoided, owing to the action of the ammonia upon it. Oleate of ammonia is employed for the joints submitted to the influence of the gas. This week we describe the different parts of the machine, reserving a description of the working for our next, when the second engraving will appear.

Figure 1 is an elevation, partly in section, and Figure 2 a plan.

First. Generators.—Generation is obtained by two generators heated by steam. A furnace *a* is placed on a bed plate *b*, and surrounded by a boiler *c*, for water, which supports and surrounds the base of a generator *d*, for receiving ammoniacal water. In the centre of the concave bottom of the generator *d* is an opening, into which the open end of a coil *e* in the generator is introduced. The upper end of the coil passes from the generator at about two-thirds of its height, and enters a second generator d^1. Fig. 2. The generator *d* has five openings in its convex cover, viz., first, an opening *f* in the centre for the safety valves and manometer, and from which a pipe *g*, Fig. 2, conducts the gas to the motive cylinder; 2nd, a tube for introducing the liquid, formed with a screw thread and provided with a cock; third, an opening *h* for a pipe B^2, one end of which reaches to the bottom of the generator; this pipe communicates by a distributing box B and a pipe B^1 with the receiver I; fourth, an opening *i* for a pipe C^6, which puts the upper part of the generator *d* in communication through a box C and connections C^1, C^2, with the lower part of four condensers K, K^1, K^2, K^3; fifth, an opening *j* for a pipe *l*, which forms a communication between the two generators *d*, d^1. The flue *m*, on leaving the boiler *c*, traverses a second under the generator d^1, whereby part of the heat is utilized. The two boilers communicate, both with regard to liquid and to steam, and the communicating pipes are fitted with a gauge or water level and a safety valve. At the bottom of generator d^1 is an opening to allow passage to the upper part of the coil *e* from the generator *d*, which is coiled in the generator d^1, and the end of which dips in the liquid of the boiler. The steam thus only enters the coil by the boiler *c*, and the water of condensation is returned to the boiler. The cover of the regenerator d^1 has also five openings, viz., first, for a tube for the introduction of the liquid; second, for a pipe B_3, Fig. 2, leading by the distributing box B from the bottom of the generator to the top of the receiver I; third, for a pipe C_6, leading by the distributing box C from the top of the generator to the lower part of the four condensers. Fourth, the opening *j* for the pipe *l*; and fifth, in the middle of the cover, for a cylinder *p*, in which a piston works, the diameter of which in relation to its stroke is in the ratio of 8 to 5. To the upper part of the piston a rod m^1 is jointed, the other end of which is jointed to an oscillating beam *n*, pivotted at its middle, the other end of this beam is connected to a piston on the top of the receiver I. The diameter of this piston in relation to that of the piston in the cylinder *p* is in the ratio of 12 to 8; the two pistons work together, one being at the top of its stroke while the other is at the bottom. The generators resist the pressure of 15 atmospheres.

Second. Receiver.—This is a cylindrical vessel I, with flat bottom and rounded top; a pipe A^5 leads from its lower part and communicates by means of the box A and pipes A^1, A^2, A^3, A^4, with the upper part of the condensers K, K^1, K^2, K^3. The top is provided with two tubes with a screw thread and a cock; a pipe B^1 leads from the cover to the box B and pipes B^2, B_3, which lead to the generators *d*, d^1. In the centre of the cover is an apparatus partly fixed and partly movable; the fixed part consists of a cylinder in which the piston works, and of a frame *q*, fixed on the cylinder, and serving as a support to the movable part, which is composed of a movable axle *o*, attached to the frame *q* by its upper part, and of the piston. When the axle *o* turns from right to left it works a toothed wheel *r*, provided with an endless chain; but when it turns from left to right the wheel remains at rest. The axle is terminated at bottom by a screw thread of a length determined by the stroke of the piston. A ring groove internally acts as a nut to the screw thread. The friction of the teeth of the ring against the thread of the screw turns the axle *o* when the piston rises or descends. The screw turns from right to left when the piston rises, and from left to right when it descends. The end of the beam *n* is forked, as shewn, and embraces the frame *q*; the piston produces a complete revolution of the wheel r^1, both in its up stroke and in its down stroke.

3rd. Condensers.—Four in number; are placed in the same plane, but lower than the receiver I and higher than the generators. They are of the same size and form as the receiver. The condenser K carries at its lower part a pipe C^1, which communicates by the box C and pipes C^5, C^6, with the generators. Its cover has six openings, including a tube with a screw thread and cock. The pipe A puts it in communication with the receiver I. The pipe E^1 communicates by the box E and pipe E^5 with the suction pipe of a suction and force pump. The pipe F^1 communicates by the box F and pipe F^5 with the same pump. The pipe D^1 communicates by the box D, pipe D^5, and the safety box O between the motive cylinder and the liquid in the condenser; its extremity is extended for this purpose into the interior of the condenser, and carries a valve, which is closed by a wooden sphere striking against a leaden ring. The valve prevents the liquid passing into the pipe and

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thence into the cylinder. It is also prevented by the safety box O, which has a liquid gauge. In the centre of the cover of the condenser K is an apparatus similar to that on the receiver, except the connection with the oscillating beam. The foregoing description of the condenser K applies to the other three condensers K^1, K^2, K^3, except that the condensers K^1 and K^2 have two tubes with a screw thread and cock, instead of one, and the condenser K^3 has a cock at its lower part.

Fourth. Distributing Boxes.—In the middle of the space between the four condensers are six boxes, A, B, C, D, E, F, with large cocks arranged in a particular manner and worked together. Each box (see the section Fig. 3) is composed of a fixed casing communicating by pipes with the vessels which it has to put into communication, and of a central movable tube. The six tubes are connected together by cylindrical blocks, not hollow, and forming an axle; this axle carries at its upper part five driving wheels; four wheels M communicate by endless chains N with small wheels r^1, worked by the pistons of the condensers; the fifth and highest wheel M^1 communicates with the wheel r of the receiver I by a chain N^1. The following are the relations established by each box:—The box A acts as a communication between the receiver I and each condenser; the box B between the receiver and each generator; the box C between the generators and the condensers; the box D between the cylinder P and each condenser; the boxes E and F act respectively as communications between each condenser and the suction pipe, and between each condenser and the force pipe o the suction and force pump Q. At the bottom there is an opening corresponding to an annular space formed in the interior of the fixed casing; this communicates with the force pipe of the pump. The movable hollow tube is formed with two openings communicating with each other by a central passage; the upper opening is exactly on a level with the openings communicating with the condensers, and the lower opening with the annular space. The interior of the box F is thus always in relation with the pump Q, but it is only in relation with the condensers as long as the upper openings coincide. Supposing communication established first with the condenser K, if the distributing axle makes a quarter turn, it will change and pass to the condenser K^1, because here the order of the pipes is the same as that of the condensers. All the boxes have not the annular space; those which should not always be in relation with one of the vessels between which they serve as communications. As the boxes, especially B, C, and D, have to resist considerable pressure, small leaden valves or stoppers are made free to slide in the openings of the fixed casing, and capable of being applied against the movable axle to prevent escape of gas.

Fifth. Pump.—This is a suction and force pump, situated behind the cylinder P, and worked by an eccentric on the horizontal shaft. The suction pipe communicates with the condensers by the box E, and the force pipe by the box F.

Sixth. Cylinder and Fly Wheel.—The cylinder P is vertical and has a double jacket; its shaft carries a fly wheel R. The machine is double acting, and works expansively.

Seventh.—Apparatus for the Expulsion of Air from the Machine, which will be described in our next.

PHILLIPS'S IMPROVED ROTARY SPADER OR DIGGING MACHINE.—In our description of this invention last week the address of Mr. Phillips was given 15, Chancery-lane. Mr. Phillip's place of business is now at 8, Southampton-buildings, Chancery lane.

BREAKING BLOCKS OF CAST IRON.—In France, the following mode of breaking large blocks of cast iron has been recently employed. A hole is drilled in the block to be broken for about one-third of its thickness, and is partfally filled with water. A steel plug is then fitted accurately into he hole, and upon this plug the ram of a pile driver is allowed to fall, when the block is at once split into two pieces.

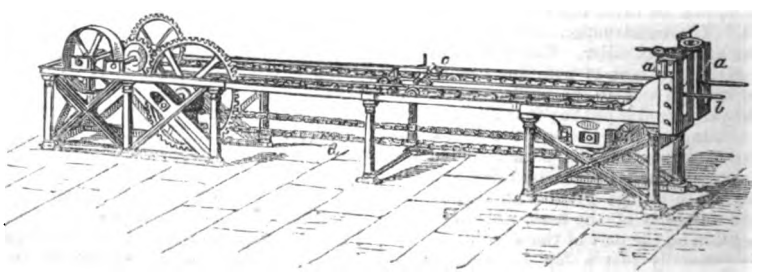
THE ART OF COINING.

III.

The gauging mill is simply a small edition of the large or breaking-down-mill shown in an illustration given in chapter two, but with more delicate means of adjustment. In this case the lower roll rests upon two sliding inclined planes of iron, which may be moved simultaneously under the bearings of the roll, and thus the latter is raised or lowered at pleasure. The gauge used for testing the thickness of the fillets of gold or silver is composed of two pieces of steel screwed together with a tapering space between, graduated and indexed to thousandths of an inch. Applied to the edges of the strips it shows at once their precise thickness. Although, however, the Mint rolls are all most carefully turned and have surfaces perfectly smooth and true, they do not produce fillets of uniform thickness. This partly arises, no doubt, from the varying density of the precious metals and their consequent different degrees of hardness. The elasticity, too, of the rolls, minute though it must be, accounts to some extent for the inequalities of thickness referred to.

In order to overcome this difficulty another apparatus has long been in use at the Mint, and it is known as the drawbench. This is a clever modification of the ancient implement used for wire-drawing, and, if constantly and skilfully attended to, it answers moderately well for correcting the evils which remain after fine rolling. In order that its nature and peculiarities may be rendered more clear than they would be by any letterpress description, we shall introduce a sketch of the drawbench. It will be seen that it consists of a long cast-iron table firmly secured to the floor of the adjusting-room in which it is placed. Along the face of the table, in shallow longitudinal grooves prepared for its reception, passes an endless pitch-chain, which returns under the table near the floor. The chain is propelled by gearing, driven in its turn by underground shafting. At the opposite end of the table to that where the gearing is seen is a massive case of iron *a a*, and this contains two pairs of steel cylinders three-fourths of an inch in diameter, 4 inches in length, and made perfectly true by lapping and being passed through gauged dies. The cylinders rest in recesses which fit their circumferences exactly and support them from end to end. The space between the cylinders is regulated by means of adjusting screws and indices on the top of the drawbench "heads." That space represents the thickness of metal necessary for the production of sovereigns, when sovereign fillets are to be dealt with, or of such other gold or silver coins as may, for the time being, happen to be in course of manufacture. Two small pairs of travelling nippers mounted on flanged wheels run freely along the edges of the chain channels, and may readily be attached to or detached from the chain itself. These contrivances are known as "dogs" *c*, and when impelled by the chain their power of biting and drawing forward what they bite is irresistable. Such are the main features of the drawbench, and its action will, it is trusted, be the more readily understood from the foregoing drawing and description of it. The rolled strips of gold on their entry into the adjusting-room are first taken to a flatting mill, which consists of a frame and two small rolls. The lower of these is quite cylindrical in form, but the upper one has three flat surfaces along it. As the pair slowly revolve and the planes of the upper one alternately come round, opportunities occur for passing the ends of the fillets easily between them. The rolls, it must be explained, turn in directions opposite to those in which ordinary mill rolls revolve, and the result is that they eject whatever may be placed between them. They, therefore, simply pinch the *ends* of the fillets offered to them, and then forcibly return the latter into the hands of the workman. This operation is a preparatory one for the drawbench, and the thinned-down ends will be finally cut off and returned to the crucibles.

The flatted fillets are now advanced to the drawbench, and are seen in the illustration at *b*. The thinned ends freely pass the cylinders, and are bitten at once by the "dog." This is attached to the chain, and the fillet—taking *one* only for lucidity's sake—is drawn steadily but determinedly between the polished surfaces of the cylinders—which it must be understood do not revolve—and thus all inequalities are smoothed away. The adjusted fillet is now dexterously released from the sharp grip of the "dog," and speedily cut into short handy lengths. So it happens with fillet after fillet in succession. Tested by the graduated gauge, it would be discovered that uniformity of substance in the fillets had now been arrived at, but a severer ordeal is in reserve. Blank pieces are punched from them by a workman known as "the tryer," and he weighs at a small balance close at hand the resulting discs. It is a *sine qua non*, as we shall by and by discover, that the individual variations in golden pieces intended for coinage must be of the most infinitesimal kind, and hence the absolute necessity for excessive care in effecting uniformity of thickness. Should the tryer by the scales test discover differences of weight, beyond a very minute point, in his hand-cut blanks, he is certain that when the fillets come to the punching presses, and are perforated as they will be from end to end, the consequences will be far from satisfactory to the officers in charge, or even to himself, for many of the blanks will in such case have at some stage or other to be returned to the melting house.



THE DRAWBENCH.

Assuming that a batch of fillets have thus been adjusted, tried, and acquitted of sensible differences, they are next transferred to the cutting-out room.

This is a circular apartment, and upon a circular platform occupying the greater portion of its floor area twelve cutting presses are compactly arranged and firmly seated. From the centre of this group of machines rises an upright shaft supporting a heavy horizontal fly-wheel, and driven by bevelled gearing below the flower line. The ring of the fly-wheel completely overhangs the cutting presses, and fixed to it below the arms are twelve cams, which are so disposed as to catch, if need be, the levers which surmount each press. This, indeed, they do when the presses are in action, and punching is going on. They (the cams) only raise the screws and punches a certain distance, and with them as many vacuum pump pistons connected by rods of iron. The levers, when released in succession, are pulled in an opposite direction by force of atmospheric pressure acting on the pistons of the pumps, and thus the downward or cutting out stroke is given.

The presses themselves consist of light cast-iron frames, through the brass nuts, in the centre

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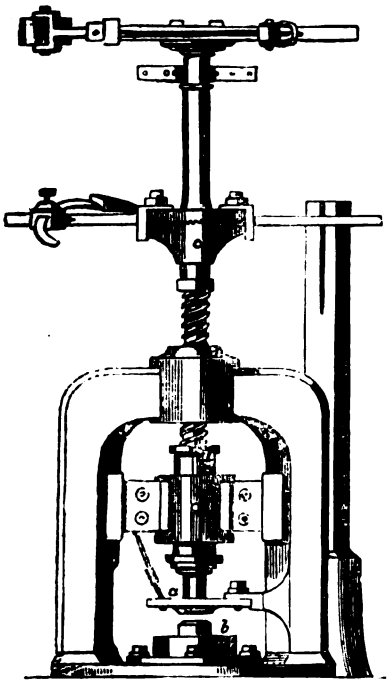
of which turn freely coarsely pitched screws, as seen in the accompanying illustration of a cutting-out press, and which is a *fac simile* of its eleven



CUTTING-OUT PRESS.

platform companions. Below the screw itself is a turned surface, passing through a brass guide within the frame of the press, for the purpose of effecting steadiness of motion. Underneath the guide is seen the punch *c*, still further steadied by another contrivance which also prevents the fillets ascending with the punch. The bed or bolster into which the punch descends, and which is of steel turned up to a sharp cutting edge at the top, is marked by the letter *b*. Of course punches of any diameter in consonance with the coin required may be attached to the presses with their corresponding bolsters. Below the latter are holes through which the punched-out discs fall, and which conduct them into boxes. The travel of the punches is small (not more than one inch), whilst the force with which they descend is readily adjusted to the thickness of the fillets, and the size of the blanks to be cut from them. This latter is managed by compound levers attached to the vacuum pumps, which are not apparent to the ken of ordinary visitors to the Mint.

Let us now return to our adjusted fillets. These are distributed freely to the press-feeders—usually boys—one of whom we observe to seat himself in front of a press. He singles out a fillet, places its end between *c* and *b*, and rests his foot on a pedal. Presto! the punch descends, and a hole in the fillet marks the point from which an embryo coin has been forced. The punch ascends by dint of cam power; the atmosphere brings it down; the fillet has been shifted meanwhile, and another hole is left in it. Another blank has tumbled into the box. At a speed of sixty strokes per minute, and somewhat noisily, the press now literally "cuts away," and soon a fillet is perforated from end to end, honeycombed as it were, and every blank it could be made to yield is taken from its surface. The boy measures his distances by the eye, and takes pains to leave no broad spaces between the holes, which indeed would be wasteful coining. So proceed his companions, and soon the whole of the fillets are punched. Constant testings of the resulting blanks are meantime made by other workpeople, by weighing, and the punches, which are of hardened steel, are occasionally reground should they require it. This again is to ensure the uniformity so much to be sought after, and which must never be lost sight of in a well regulated mint.

When the day's cutting-out is completed, the blanks are collected, and, in bags containing 720 ounces, or 2,804 pieces, they are deposited in a stronghold. The strips are bound up, faggot like, and condemned again to the fiery furnace of the melting-house for reconversion into bars.

On the morrow the blanks are sent forward to undergo the next process, which is that of "marking" or raising upon each its protecting rim.

It has been stated in some of our Cyclopædias that what is known as the "milling" on the edge of gold and silver coins is given to blanks *before* they receive their impressions. This, however, is a mistake, as we shall have occasion to demonstrate before concluding the present series of papers on the "Art of Coining." The fact is that the Cyclopædists have confounded the terms "marking" and "milling," and thus led their readers into error. The operation of marking consists in compressing the edges of the blanks, and thus preparing them for the subsequent reception of the ingrailing or beading from the dies. It is well known that all coins when issued from the Mint have raised circumferences for the preservation of the devices which ornament their surfaces. If the surfaces required to be depressed by the force with which the dies struck the blanks, to a sufficient extent to leave the edges standing boldly up, it is certain that the strain upon the dies would prove fatal to very many of them. The marking or edge-raising process obviates this evil, and it is performed at a very rapid rate. In the marking department of the Mint considerable improvements have of late years been effected. The old contrivances for marking were complicated, ineffective in their results at the best of times, and liable to easy derangement always. They have disappeared, however, and machines of a novel and far superior character have taken their places.

To Mr. M. Jones, an artificer of the establishment, belongs the merit of effecting the improvement. He devised and patented an edge-compresser which is easily adjustible to the different sized coins of the English series. The machine of Mr. Jones's invention consists mainly of a steel-faced disc of some twelve inches diameter, mounted on a spindle, and running in annular bearings so as to avoid back thrust. The disc, which runs vertically, like a surface-chuck in a lathe, has a groove as broad as the thickest coin, and of about 1-16th of an inch in depth, turned in its face, and near its outward edge. Firmly screwed to a bed-plate in front of the disc is a steel cheek, some four inches in length, which also has a groove of similar dimensions to those described, and which forms a segment of the same circle as that of the groove o the running disc. An inclined spout, the lower end of which terminates at the point where the two grooves face each other, serves as a conducting medium for the blanks. A hopper receives the latter, in the first instance, from the hands of the workman. Beneath the hopper a wheel or pulley, with serrations on its periphery, of slight depth, and one inch and three quarters pitch is made to turn. The column of blanks in the hopper rests upon this wheel, between the serrations, and the lowest blank has just sufficient space between it and the hopper to allow of its being carried forward when the wheel commences its revolutions. It will now be comprehended that the feeding arrangement for the marking apparatus is complete.

(To be Continued.)

ELECTRO-METALLURGY.

SEAWEEDS AND FERNS.—I have noticed frequent inquiries by correspondents as to the mode of copying these, and I have read many books that pretend to give instructions for doing it, but I shall not mislead you by stating the process as easy, for many cannot be done, and with others only by destroying the natural bends of the leaves and crushing the fibres. However, there are a few that can be copied by patience and care. Lay the leaf upon a sheet of paper, and with a camel-hair brush paint the side exposed to view with the gutta percha solution mentioned in a previous chapter; build layer after layer until it is about ⅛ thick; allow it to stand a night; the plant then can be torn away, and the mould be blackleaded in the usual manner.

Some leaves may be blackleaded and typed direct. You thus procure a metallic negative, which is more perfect than any other.

LEAVES OF TREES.—Many, if not most of these, offer similar obstacles to seaweeds and ferns, but the same process applies to both.

I have seen many specimens of ferns and leaves typed, but they illustrated patience and perseverance, without being worth the trouble taken.

FISHES, REPTILES, AND INSECTS.—Some species can be cast in fine plaster in halves, the subject removed, and molten lead poured in their place. Touch up the imperfections, and cover with copper by the type process.

I must here mention that the bath requires some alteration for depositing on lead, tin, zinc, iron, and a few other metals.

I should recommend the removal of the strong solution from the bath; put it aside for future use.

Now pound some crystals of copper, say half a pound, and put them in a basin or jug that will hold sufficient water to fill the bath; stir well for one or two minutes with a glass rod, then pour off the liquid into the bath until it is nearly as full as you require; now mix half a gill of liquor ammonia with same quantity of water, and add it gently to the solution, and continue to pour in until a white precipitate falls.

If too much precipitate falls before you notice it, it involves filtering, otherwise it is apt to adhere to the mould, and prevent the copper taking.

To cover zinc and iron no battery is required; simply place it in the solution made as above for one minute.

CARBON PLATES FOR BATTERIES.—Electrotyping is exceedingly useful in preparing carbon plates to receive the lug or metal strap. Proceed as follows:—Attach the carbon plate to the zinc of battery, and lower into the bath to the depth of half or three quarters of an inch. In half an hour sufficient copper has been deposited. Remove and rinse in clean water; do each plate in this way, and then put them in a warm place to dry. Upon this coating you may solder the strap. Cover all with sealing-wax varnish. Large plates are frequently rivetted to the strap, as well as soldered; in such cases drill the carbon first, type it after, then rivet and tin.

Coke, charcoal, carbonised straw, paper, rope, &c., may readily be coated. Specimens of straw, paper, &c., are to be obtained at many gas works, and plated, gilded, or coppered look very pretty.

Smoke-marks, lampblack, or soot, are conductors. MOMUS.

TRACING BY SUNLIGHT.

Photography has long ago greatly diminished the less skilled labours of the mechanical draughtsman. Instead of the laborious finished and coloured drawings intended to show forth the chief characteristics of a machine, without at the same time telling too much about its construction, photographs, coloured or not, are now used. It has sometimes struck us, by the way, that the bright parts of such photographs could be neatly brought out by means of a spare and tasteful use of the silver and gold paints sold in mussel shells in most print shops. However this may be, photography is now extensively used in producing tracings of machinery of which a number of duplicates are required; and we saw, the other day, some beautiful specimens of the kind. We feel convinced that it is destined to largely supersede lithography, with which it can compete commercially for any number of copies up to one hundred. It has been found most convenient to carry out the process some miles from London, in order to avoid the "blacks" of the atmosphere of the district; and even a large order can be carried out in one day. The process, briefly described, consists in submitting the original tracing, or even the drawing, to the light, a chemically prepared sheet of paper being placed underneath. This idea, *per se*, is not novel, but its practical execution is the subject matter of a patent.

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PROGRESS OF INDUSTRY.

Art Workman's Exhibition at Manchester.—An art workmen's exhibition at the Royal Institution in Manchester was opened on the 26th ult. Lord Houghton spoke at some length on the advantages of such exhibitions, as tending to promote popular taste in art and improve popular manners. The present exhibition contains about 400 contributions, which are the work of 200 workmen. We are glad to learn that this exhibition differs from a previous one of a similar kind at Manchester last year, inasmuch as most of the present contributions are the work of regular working men, produced during the ordinary hours of work, while the former one was mainly furnished with works by amateurs, which were the productions of their leisure hours. The aim of both has been to display and stimulate the art of workmanship of the Manchester district. The germ of both is said to have arisen out of a desire of the Manchester house decorators, painters, and grainers to display their ability and remove a prejudice in favour of "foreign talent." The contributors are, for the most part, the individual artisans who have executed the work, and their names are attached; but in many instances the article exhibited is sent by a firm of employers, who specify if possible the names of the workmen engaged upon it. The contributions include panels decorated with the utmost care of the painter or grainer in imitation of marbles or woods. The plasterers contribute some original designs in their method of ornamenting interiors, and there are also some good specimens of gilding and cabinet work, and original designs for wall papers. Stone and wood carvers appear in great force, and among the former is a panel in Caen stone representing the "Good Shepherd;" a tablet representing "Christ inviting the weary and heavy-laden;" and a bust of a girl with the face veiled. There are some specimens of floor tiles, and a considerable number of models and drawings of machinery. The contributions are from within a radius of 25 miles of Manchester, and altogether the exhibition is a very interesting one.

RECENT RESEARCHES ON METALS AND ALLOYS.*

The importance of the subject which I intend to bring before you this evening is so extensive, that it ought to be the subject of a series of lectures instead of attempting to condense it into one, and, therefore, I shall only give a *resume* of some of the discoveries which have been made during the last two years.

You are probably all aware that England occupies the first position among nations as a source of mineral wealth, and to enable you to appreciate the truth of this assertion, allow me to cite a few figures, published by Mr. Robert Hunt, F.R.S., the keeper of mining records of the Royal School of Mines. In 1863 the value of minerals produced was £29,151,976, from which metal of the value of £36,364,327 was extracted. There were produced—

Tin ore . . .	15,170 tons
Copper ore . .	212,947 "
Lead ore. . .	91,283 "
Silver ore . .	88 "
Zinc ore . . .	12,941 "
Iron ore. . .	3,500,000 "

Further, it is interesting to compare the results given by Mr. Hunt in 1858 with the above, for we find that the mineral wealth of England has nearly doubled in five years, for in 1858 the value of the metals produced amounted only to £18,105,708. I must not omit to state that, during the last few years, England has also taken the lead in the manufacture of aluminium (Jno. Bell and Co., manufacturers, Newcastle) and magnesium, by Messrs. Mellon and Co., Salford, who have adopted the method proposed by Mr. Sonstadt. As to the four new metals which have been of late discovered, viz., cæsium, rubidium, thallium, and indium, they are as yet but scientific curiosities, but as their discovery is due to spectrum analysis, I shall refer to them more especially when treating of the method by means of which the discovery of these metals has been made, an illustration of which I shall be able to give, through the kindness of Mr. Ladd, who will show you the various spectra on the screen at the conclusion of the lecture.

Since I had the pleasure of drawing your attention last year to the then novel application of magnesium to the art of photography, owing to the intense light which that metal produces (for it has been calculated to be equal to 1-525th part of that of solar light, and has been seen at a distance of twenty-eight miles at sea, and also to its intense actinic power), Mr. Bultinck has proposed the substitution of this metal for zinc in galvanic batteries, and states that he believes the substitution would prove a very advantageous one to electricians. The employment of this metal will be greatly facilitated by the the large works which have been erected for its manufacture at Boston, in America.

Although Mr. Faraday observed many years ago that light was transmitted through thin leaves or sheets of the following metals: platinum, palladium, rhodium, gold, silver, copper, tin, lead, iron, and aluminium, still we were not prepared for the interesting results that Mr. Quincke has obtained and published in the *Philosophical Magazine* for March, 1864. That gentleman endeavoured to determine directly the velocity with which light travels through metals, and he found, strange to say, that it travels faster through gold and silver than through a vacuum. Further, he adds that he was unable to detect any difference in the components of the light which had previously passed through transparent substances, such as plates of glass. The comparative rapidity of light in passing through metals and a vacuum appears to me to be in favour of the new theory of light, which I took the liberty of expounding to you in my first lecture. Although we could conceive the passage of light through a thin film of metal, still chemists were astonished when M. Henry St. Claire Deville, whose name I have had the pleasure of often citing in these lectures, published, conjointly with M. Troost, some interesting papers on the porosity of substances under the influence of high temperatures. His experiments enabled him to show that even platinum and wrought iron tubes, the latter one-eighth of an inch thick, are, when carried to a high temperature, permeable to gases. The importance of these results cannot be overrated by chemists when the permeability of platinum is considered, as that metal has been employed by them under the conviction that its high density and mode of manufacture destroyed all porosity. As to iron, the knowledge of that fact is most important, especially in the manufacture of coal-gas, where iron retorts are used for distilling the coal. So complete is the permeability of iron at a high temperature, that an iron tube which had been filled with hydrogen gas before the experiment was found to contain only a trace of it at the end of a few hours.

Considering the short space of time which I have at my command, I can only state that you will find in the Royal Society's *Transactions* (vol. clii., part 1, page 1) a most elaborate paper on "The Influence of Temperature on the Electrical Conducting Power of Metals," and also vol. cl., part 1, page 85) on "The Conductibility of Copper." These researches of Dr. Matthiessen deserve the close attention of all electric telegraph engineers.

The study of metals must convince every student that, although science has progressed in a marked manner during the last fifty years, still that there is a great deal more to do than has been done. Although we have known copper, zinc, lead, tin, and iron for many centuries, still hardly a month passes without new properties of these metals being discovered, or facts connected with the improvement of their manufacture or the removal of the impurities they contain. I, therefore, deem it my duty to advert to a few papers that have been published recently respecting certain impurities which particular metals contain, which impurities, in some instances, enhance the value of the metal, and in others lower their commercial value. No class of substances teaches the young chemist the difficulties and the labours he must be prepared for, if he wishes to be what is technically termed a good operator, and if he pretends to prepare a pure substance. I would, therefore, advise all young men studying chemistry, carefully to read the labours of J. S. Stas on "The Determination of the Equivalents of Chlorine, Sulphur, Nitrogen, Silver, Potassium, Sodium, and Lead," published in the *Moniteur Scientifique* of 1861 and 1864, where they will notice that Stas has spent months of time to obtain a few ounces of *pure* silver, lead, &c.

Copper.—The same may be said of the researches of Matthiessen to obtain pure copper, for his studies above alluded to have enabled him to state that there is no alloy of copper which conducts electricity better than pure copper (page 92 of the above memoir), for he found that the most minute quantities of arsenic, phosphorus, sulphur, selenium, tellurium, and oxygen diminished the conducting power of that metal. Whilst on the impurities of copper, I must not fail to mention some valuable additions which Messrs. Abel and Field have published in the *Journal of the Chemical Society of London*, on the means of determining various impurities which copper contains; thus they found sometimes traces, and sometimes several per cent. of the following impurities in many samples of commercial copper, silver, arsenic, antimony, bismuth, lead, tin, and iron (see Tables, vol. xiv., page 302), and Mr. Abel in a paper inserted in the same journal in 1864, proved that copper contained sulphur, as a general constituent, but only in minute quantities; selenium, as an occasional constituent; and that oxygen was always present and sometimes in considerable proportion; thus, in dry copper he found the quantity of oxide of copper, not as Messrs. Dick and Percy have stated, from 10·21 to 9·34 per cent., but from 3·77 to 4·56 per cent. Mr. Abel gives the following numbers as representing the average proportion of oxygen obtained with a series of samples taken in diverse stages in the manufacture of copper:—

	Oxygen per cent.
"Dry" copper . . .	0·42
Ditto (another specimen) .	0·50
"Half-poled" copper . .	0·20
"Tough-pitch" " . .	0·03
"Over-poled" " . .	0·03

(*To be continued.*)

* Abstract of Lecture by Dr. F. Crace Calvert, F.R.S., F.C.S., being the 6th Cantor Lecture at the Society of Arts, May 16th, 1865.

A SELF-LOADING SHIP.

M. De Coraux, a Lyonnese, has invented and constructed a ship which can load or unload itself automatically in forty minutes. The captain and mechanician are the only living crew on board, the working and manipulation of the vessel and cargo being all performed by steam applied to most ingenious machinery. The loading is carried on by trucks and wagons, which can contain corn, flour, bales, cattle, horses, barrels, &c. The vessel is, as may be expected, of a peculiar disposition; but its exterior bears all the signs of sea-worthiness. The great revolution is on the deck and in the interior. The former is covered with lines of rail, reaching from one extremity to the other, while, at midships, there are two turntables. Front and rear are two or four immense cages, containing eight, twelve, or sixteen waggons, of the same size as our railway-waggons. The rails on which the waggons rest are adapted exactly to the rails of the deck. A cable is hooked to the waggons, which traverse the deck throughout its length, and the stern of the boat having been previously placed on a level with the quay, which is also furnished with rails, or may be, perhaps, a portion of a terminus, the waggons glide without the least interruption from the vessel to the land, and *vice versa*.

A Scottish nobleman, who is connected by property with the Orkney Isles, has offered, it is said, to subscribe £60,000 for the construction of railways in Orkney.

The Chertsey and Virginia Water Railway will be opened shortly, and is likely to prove profitable. A line from Blackwater to Sunningdale is also under construction.

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COMPASSES OF IRON SHIPS.

On the 29th ult., a paper was read by Evan Hopkins, Esq., at the United Service Institution, on the compasses of iron ships. The paper was a most elaborate one, but we are compelled by want of space to limit our report to the following brief abstract:—Setting out with the assumption "that the acquired polarity from induction and position is generally acknowledged to be the principal cause of 'deviation,' and the danger attending the sailing of a new iron ship," Mr. Hopkins proposes to destroy this polarity, either before or after launching, by the application of powerful electro-magnets, thus obviating the necessity for "swinging." The ship is to be treated as a huge bar-magnet which is to be demagnetized, but Mr. Hopkins gives no details of his process, which he admitted had not yet been tried. It must, however, always be borne in mind that even if we were able to destroy the polarity of iron ships, either by Mr. Hopkins' or any other method, or to prevent it altogether by altering the position of the ship in the various stages of its construction, the iron still remains susceptible to magnetic influences. It is true that Messrs. Evans and Smith have shown that there is a constant and regular diminution both in the quadrantal deviation and in the directive force with the lapse of time, showing apparently a change in the molecular structure of the iron, by which it becomes less and less susceptible of induced magnetism. Mr. Hopkins further recommends that the steering compass be raised to such an elevation as will place it beyond the reach of the influence of the ordinary attraction of the wrought iron of the vessel. In order to read the compass, a reflector is fixed near it, so that it may be correctly read at a distance of twenty feet from the steering wheel. He makes his compass needles of the strongest directive power, so as to avoid unsteadiness and excessive oscillation. For high latitudes, where straight needles are found sluggish in their movements, he purposes to bend the needle "to the average angle of the dip." "A flat needle," he says, "if bent to the angle of the dip at the centre, will not only have its directive polar power increased, its vibrations will be reduced to one-third." Our knowledge on this most important subject is, it must be confessed, in a most unsatisfactory state, and we hardly think that Mr. Hopkins' researches, in their present state, will help us much. In his introduction he states that "a small needle can be retained in the centre of an helix of a battery without any apparent support." This is, we believe, not so, although it is to be found in the writings of many eminent men. Professor William Thomson says "the phenomenon of a solid body, hovering freely in the air, in stable equilibrium, without any external support or constraint, has never, I am convinced, been witnessed as the result of any magnetical experiment." (*Philosophical Magazine* xxxvii., 250.) Mr. Hopkins' method of accounting for this supposed effect is curious. He thinks it is due to "the presence of a dense magnetic fluid concentrated within the spiral by the electro-magnetic force."

The Cigar Ship.—The Ross Winans, better known as the "cigar ship," has been launched at Hepworth's yard, Cubitt Town, Isle of Dogs. This ship, unlike a cigar, is pointed at both ends, tapering gradually and smoothly from the middle. It has two screws, one at each end of the ship, but not fixed beyond the pointed extremity, where there would not be room for efficient bearings for the screw shaft. For this reason each screw is 18 feet nearer the centre of the vessel than the points, the cone thus left at each extremity being attached to the shaft and allowed to revolve with the screw. The screws are 22 feet in diameter, and have eight blades each. A wooden deck, with bulwarks partly of the same material and partly of iron, is attached to the outside of the cylinder, this external appendage having the shape of one of the ordinary Thames river steamboats, but it has two vertical iron funnels, and two light telescopic masts. Thus in the water the vessel loses much of its cigar-like appearance.

IMPROVEMENTS IN PUMPS.

An invention has been provisionally specified by Mr. Honoré Maury, which consists in thus constructing pumps:—Upon two hollow columns, which serve as the suction and discharge pipes of the pump, he mounts a horizontal cylinder, the interior of which is in communication with the interior of each of the hollow columns. Within the cylinder a drum is caused to rotate on horizontal axes. This drum is always in contact at one point with a longitudinal packed rib on the inner surface of the cylinder, which shuts off direct communication between two hollow columns; the drum is not in contact with the cylinder at any other point, but carries four or other number of spring pistons, which, as the drum rotates, bear against the inner surface of the cylinder. These pistons are fitted in pairs at diagonally opposite points of the drum, each pair being connected by a tube passing through the axle of the drum. A spring is fitted behind each piston, and keeps it in contact with the surface of the cylinder. As the pistons in their revolutions approach the longitudinal rib before mentioned they recede into the drum until they have passed it, the corresponding piston being forced out on the opposite side. The cylinder is closed at each end by a plate; one of the plates is formed with an aperture and stuffing-boxes to receive the axle of the drum, and the other plate has on its inner face a socket to receive the other end of the axle. The plates are fixed to the cylinder by bolts, India rubber or other washers being interposed to make the closing hermetic. The inner face of each plate has an annular groove filled with leather, for the ends of the drums to bear against. The cylinder is formed with two openings near its upper part for use in priming or starting the pump when required. These openings are closed hermetically by plates. One of the hollow columns is in communication with the well, and each column is formed with a socket to receive a pipe when required. When the liquid had to be raised from a great depth, he fits the column in which it is raised with a valve to prevent the return of the liquid. The action is this:—The drum with the pistons being caused to rotate by a crank handle in connection by toothed gearing with the axle of the drum, or in any other convenient manner, the pistons produce a vacuum in the first column, the liquid rises therein, is carried by the pistons round the upper parter of the cylinder, and enters the other column, from which it may be led to any desired point. The action of the pump may be reversed, so that the discharge pipe becomes the suction pipe, and *vice versa*.

DRAKE'S GAS ENGINE.

More than ten years ago, an engine driven by the explosion of a mixture of coal gas and atmospheric air was introduced in America, by Dr. Alfred Drake, of Philadelphia. At the present time when gas engines are coming into use for many purposes, an account of the engine may prove interesting as it is so little known in this country; and indeed we believe that no account of it was published here until after the introduction of Lenoir's engine. The principal feature in Dr. Drake's engine was the means employed to light the mixture of gas and air within the cylinder. In Lenoir's engine this is effected by an electric spark. It must be remembered that in a gas engine the mixture of air and gas must be admitted to the cylinder for a considerable proportion of the stroke before it is ignited; the engine performing this portion of the stroke by the aid of the momentum stored up in the flywheel during the previous one, as the gas does not exert any considerable pressure until it is exploded. The slight pressure which it does exert, is merely due to its being slightly compressed by an air pump at the same time that it is mixed with atmospheric air.

In Dr. Drake's engine, the mixture of gas and air was ignited in the following manner:—At two points, one for each stroke, a hole was formed in the cylinder; the distances of these holes from the ends of the cylinder corresponding with the distance for which the mixture was to be admitted before it was exploded. These holes were each furnished with stuffing boxes, and in each of these stuffing boxes was placed a cast-iron cup, or thimble, the solid end of which projected into the shell of the cylinder, so as to be just clear of the bore. In each of these thimbles a jet of gas and air was constantly kept burning, and by this means the ends of the thimbles were maintained at a red heat. When, in the course of its stroke, the piston passed over one of these thimbles, the mixture of gas and air which had been admitted behind it, came in contact with the red hot surface and was instantly ignited. The explosive mixture was admitted to and released from the cylinder by ordinary double-beat valves.

We have said that the gas and air were slightly compressed during their mixture. This was effected by an air pump furnished with suitable stopcocks, by means of which the proportions of the gas and air could be regulated. The air pump was worked by hand, in order to obtain a supply of the explosive mixture for starting the engine; afterwards it was worked by the engine itself. The explosive mixture used consisted of one-tenth coal gas, and nine-tenths atmospheric air, and it was considered by Dr. Drake that when this was ignited, an initial pressure of 150 to 200 lb. per square inch was obtained. From experiments which have been since made, however, we believe that the united pressure obtained by the ignition of a mixture of gas and atmospheric air is very much less than that above given.

The ignition of the gas in the cylinder of course causes considerable heat to be evolved, and in Dr. Drake's engine, therefore, the shell of the cylinder, the cylinder covers, the piston and the piston rods, were all made hollow, and through them a constant stream of water was maintained. By this means they were kept moderately cool. The speed of the engine was controlled by a throttle valve connected with a governor, as in an ordinary steam engine. The fact of this engine never being used in America to any considerable extent is partly due to the death of Dr. Drake, and partly to the excessive price of gas in that country (12s. 6d. per 1000 cubic feet in New York at the time of its introduction). Dr. Drake's engine was worked in the New York Crystal Palace in 1855.—*Engineering.*

Casing Buildings.—Works have been begun for the casing with stone of that portion of the exterior of the Houses of Parliament which was left in brick in order that the structure might be continued on the north side of Palace Yard, opposite the entrance of Westminister Hall. It would appear that a garden is to occupy the site of the houses which formed the south side of Bridge-street, Westminster. We are afraid the casing operation will not be a fortunate one; at any rate, the difficulty of covering so large a space as that in question will be great, if panelling only is to be employed to make it interesting. Nothing more wealthy of meaning than machine-made Perpendicular panelling must be looked for here. The pedimented windows of the so-called Anglo-Italian style are only less tolerable than the pattern-like poverty of such false Gothic decorations.

Shoreditch Working Men's Club, Union-street, Kingsland-road. — The half-yearly business meeting of the members of this institution was held on Tuesday, the 30th ult. There was a numerous attendance. The report congratulated the members on the progress of the Club during the last six months. The library of several hundred volumes had been largely used by the members. Arrangements had been made for the formation of fresh classes, and at the present time classes for writing, arithmetic, discussion, elocution, and shorthand were in operation. The balance-sheet showed an expenditure of £45 4s. 4d., and receipts amounting to £54 11s. 7d., the whole of which had been raised by members' subscriptions, entertainments, &c., with the exception of a donation of 21s. by the Vicar, leaving a balance in hand of £9 7s. 3d. Officers were elected for the ensuing half-year, and the proceedings closed with a vote of thanks to the chairman.

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THE CHEMISTS AND THE BOARD OF INLAND REVENUE.

A question of importance to photographic and other chemists has just been decided. It seems that an excise officer bought some strong alcohol of Messrs. Horne and Thornthwaite, and then laid an information against the firm. Messrs. Horne and Thornthwaite thereupon wrote to the Commissioners of Inland Revenue, stating that in 1856, when supplying the photographic outfit to the Royal Engineers, they had, through the late Captain Fowke, inquired of the Board whether they were allowed to sell alcohol for photographic or scientific uses, and the reply given was to the effect that no notice would be taken of such sale. Messrs. Horne and Thornthwaite also urged that the spirit supplied by ordinary dealers was useless for scientific purposes. They stated, further, that they were of opinion that they were fully justified in selling an alcohol the strength of which is so high that it cannot be tested by Sikes' hydrometer, as such an article could not have been contemplated by the Act, which directs all spirits to be tested by Sikes' hydrometer; and they concluded by appealing to the Commissioners, on their own behalf and the many other establishments interested, to decide what they might legally sell. The reply of the Commissioners will be found below. We may add that Messrs. Horne and Thornthwaite have been advised not to sell alcohol under 60° over proof, and in quantities of not more than one gallon at a time :—

"Inland Revenue, Somerset House, London,
"W.C., 30th January, 1866.

"Gentlemen,—The Board of Inland Revenue having had before them your application of the 17th instant, I am directed to state that the law absolutely prohibits the sale of any spirit without licence, but that this department is not in the habit of interfering with chemists who sell small quantities of highly rectified spirits, such as cannot be procured from ordinary spirit dealers, for medical and scientific purposes only.

"I am, Gentlemen, your obedient servant,
"Adam Young, Assistant-Secretary.

"Messrs. Horne and Thornthwaite."

GEOLOGY.

Rain and Rivers.—In the *Journal of the Geological Society*, published in November last, Messrs. Foster and Topley, of the Government Geological Survey, attribute the denudation of the Weald *Hill* to "Rain and Rivers." More than this, there appears to be a strong tendency to the "Rain and River" theory among the young practical geologists of the Government Survey (who have no theories of their own to defend), whether in England, Ireland, Scotland, Canada, or India. So far so good. Great A is accomplished; but there is still a great B to be learnt. The great B is, that man and mammalia, that is, the most perfect creatures, may have existed on the land from the beginning, and *before* the first strata were formed in the sea, and consequently that Darwinism and the "development" theory are myths. The entire surface of the earth is covered with soil. That soil is rotted subsoil. Owing to atmospheric disintegration, soil is in constant formation over the entire surface of the earth. Owing to the erosion of "Rain and Rivers," that soil is in constant movement down the hill-side to the valley, and along the valley to the sea. The land, then, is the region of perpetual disintegration, denudation and destruction. The sea is the region of perpetual deposit and conservation. And sea strata, when hoisted up by heat in the form of slate, sandstone, limestone, &c., form museums of sea life of ar antiquity quite incomprehensible to man. But these museums contain sea life only; land animals neither live nor die in the sea; they live and die on the land. And where are the museums for the preservation of ancient land life? There cannot be such a thing. The entire surface of the earth is perpetually vanishing, and with it the museums for the preservation of ancient land life. The most ancient museums of land life are caverns, filled up lakes, and drift and alluvium—things which, speaking geologically, were formed yesterday, and will be gone to-morrow. In these modern land museums, however, the remains of man and mammalia are found, and they *would* be found in more ancient land museums, if such ancient land museums *could* exist. In the *Geological Magazine* of January last, page 2, the editor tells us that "Foraminifera of the present day form no less than 95 per cent. of the ooze covering the *floor* of the wide Atlantic ocean." Suppose our present continents to be destroyed or submerged—

And where the Atlantic rolls wide continents *shall bloom* ;

—that is, suppose that this "floor of the wide Atlantic ocean," turned into slate, shall be raised up as the Silurian slates have been : is the wiseacre geologist of after ages to dub this Foraminifer the *Eozoon Atlanticon*, and to inform his pupils that it was almost the sole existent animal of the *period* of that deposit, instead of the *place* of that deposit? That is, that from the beginning of the world up to the 19th century inclusive, Foraminifera were the dominant race on this terraqueous globe? Yet this is the argument of our present geologists as regards the Eozoon Canadense, the Oldhamia Antiqua, and the Silurian Trilobites. The whole affair is the result of the most childish confusion between space and time, between place and period. That is, because in the deposit of a certain *place* such a life only existed, we set it down that in the *period* of that deposit that life only existed. Hence such errors as "The age of reptiles," "The diluvial period," "The boulder period," "The drift period," &c.—*Athenæum.*

ART NOTES.

Those who remember the most interesting and extensive collection of water-colour drawings by English artists which took place in 1863, at Streatham, will be glad to know that, on the 5th proximo, a similar collection will be opened in the New School Rooms, Streatham Common, and continue open until the Saturday following. The collections of Messrs. Leaf, Quilter, Griffith, Bicknell, and others, will supply materials, which are not only of the highest quality, but rarely seen by the public.

The Government is betimes in inviting a competition of architects for the honour of designing the new National Gallery. The following gentlemen have been asked to compete in the matter: Messrs. G. G. Scott, Banks and Barry, D. Wyatt, G. E. Street and C. Brodrick—a provincial architect, who obtained the lowest prize in the competition for the New Museums at South Kensington.—A similar limited competition is announced with regard to the important task of designing the new Law Courts. The architects selected are Messrs. G. G. Scott, Banks and Barry, G. E. Street, Waterhouse, D. Wyatt, and Hardwick.

A Fine-Art Gallery will shortly open in York.

The publication of the "Fine Arts Quarterly Review" will shortly be resumed by Messrs. Day & Son.

At the Gallery of the Institute of Painters in Water-Colours may be seen an interesting collection of drawings, by M. Hildebrandt, representing scenes and customs in China, Japan and Manilla.

An Art Gallery is to be erected near the Free-Library and Museum at Liverpool, the cost to be defrayed by a loan on the security of the Library and Museum rate.

The Soane Museum, Lincoln's Inn-fields.—The trustees of this institution, which is situated on the north side of Lincoln's Inn-fields, have issued a notice to the public intimating that it is their intention, as hitherto, to open the establishment to the public on Wednesday next, on each Wednesday of the following month of March, and on Wednesday, Thursday, and Friday of the months of April, May, and June, and on Wednesdays in the months of July and August. The collection contains some of the finest specimens of Greek art.

Loan of Works of Art.—Lord Stanley of Alderley's Bill, which has passed a second reading in the House of Lords, provides that trustees of works of art, who by their trust deeds are prohibited from lending them, may nevertheless lawfully lend them, if they choose to do so, to the National Portrait Exhibition, and to the Paris Exhibition of 1867.

CHEMICAL NOTES.

At the Academy of Science, Feb. 12, M. Pelouze read a memoir "On the Composition of Soda made from Chloride of Sodium by Leblanc's Process." The author does not believe in the formation of an oxysulphide of calcium, thus agreeing with Messrs. Gossage and Kynaston. The memoir is of considerable length, so we only give the author's *resume*. His analyses and a study of the reactions of the different substances, he says, have led him to the following conclusions :—1. That black ash is a mixture of carbonate of soda, sulphide of calcium, carbonate of calcium, and free lime. 2. The ash, on *prolonged* contact with water, hot or cold, gives an amount of caustic soda proportional to the free lime the ash contains, and then the lime in the waste is completely neutralised by sulphydric and carbonic acid. But (3) as the waste obtained in the ordinary process of manufacture has not been placed in circumstances to ensure the complete reaction of the lime on the carbonate of soda, such waste usually contains free lime. 4. Any black ash being given, free lime may be left in the waste or not, just as the lixiviation is managed. And he adds (5) that nothing has yet demonstrated the existence of an oxysulphide of calcium, nor any other compound of lime and sulphide of calcium.

New Test for Uric Acid.—Dr. Dietrich has remarked that when a bromated alkaline solution of hypochlorite of soda is added to urine, an intense rose-red colour is produced. The colour disappears after some time, and quickly on the addition of more of the bromated solution. It probably, he says, depends on the formation of alloxantin. The experiment answers well with serpents' dung, but is difficult to recognise with pigeons' dung and guano, because the substances themselves are of a dirty brown colour. This test may, in many cases, replace the murexide test, since it is made with little trouble and in a short time.—*Zeitschrift fur Analyt. Chem.*, p. 176.

Behaviour of Turmeric Paper towards Boracic Acid and Zirconia.—Boracic acid and zirconia redden turmeric paper in a very similar way; but the paper reddened with boracic acid and dried at 100° becomes coloured a beautiful deep blue on being touched with a dilute solution of potash, while that reddened by zirconia is only affected as usual by an alkali. Fluoborate of potash after the addition reddens turmeric like other boron compounds; fluozirconate of potash subjected to the treatment reddens the paper very little, and only at the edges where it is in contact at once with the acid liquid and the air. Vogel and Ludwig have already remarked the action of an alkaline solution on paper reddened by boracic acid.—*Kraut. Zeitschrift fur Analyt. Chem.*, p. 168.

GLEANINGS FROM SCIENTIFIC WORKS.

It has been shown that immense pressure will prevent water from freezing at 32 deg., on account of ice occupying a larger volume than that of the water which forms it.

The area of the large hydraulic press used in the construction of the Britannia Bridge was 314·16 square inches, and the capacity with a 6ft. stroke, 22,619 5 cubic inches.

In 1844. 2 cwt. of gutta-percha were sent to this country as an experiment from Singapore. The exportation rose the next year to 169 piculs (the picul is 133⅓lb.), and in 1848 it was 6,768 piculs.

Animals fed on farinaceous food exhale a quantity of carbonic acid equivalent to the oxygen inspired, while animals fed on animal food absorb oxygen sometimes equal to four parts in ten of that inspired.

M. Fizeau has determined by experiment that a ray of artificial light travels at the rate of 70,000 leagues in a second of time. Astronomers have given the rate of solar light at 192,500 miles in the same time.

The comet of 1845 approached within 60,000 miles of the sun, the nearest approach to that luminary ever actually observed.

Pouillet pointed out, in 1822, that when a fluid is absorbed by a porous substance, a rise in temperature takes place.

The tenacity of iron at a temperature of 212 deg. Fah. is less than at 32 deg.; but at 392 deg. its tenacity is greater than at 32 deg.

The force of the waves of the German Ocean has been found to be about one and a-half tons per square foot; that of those of the Atlantic three tons.

In the year 1745 a woman at East Dereham, in Norfolk, spun a single pound of wool into a thread 84,000 yards in length, or nearly forty-eight miles. Since that time a young lady of Norwich has spun a pound of combed wool into a thread of 168,000 yards; and she actually produced from the same weight of cotton a thread of 203,000 yards, or upwards of 115 miles; this last thread, if woven, would produce about twenty square yards of muslin.

In 1852 the Wave Queen, an iron vessel, was launched by Messrs. Robinson, Russell, and Co., at Milwall. She was 200 ft. long, and only 13ft wide; engines of 80-horse power; and she went to Denmark and back more than once. This is possibly the largest ship, for the length, ever built.

An error in placing a fine dot, which fixes the length of the rod used in measuring a base line in astronomy, amounting to 1-5,000th of an inch (the thickness of a fibre of silk), will amount to an error of 70 ft. in the earth's diameter, of 316 miles in the sun's distance, and of 65,200,000 miles in that of the nearest fixed star.

The drawings in the first lottery in England, as far as is ascertained, began on the 11th January, 1569, at the west door of St. Paul's Cathedral, and continued day and night till the 6th May. The scheme was announced two years before, and showed that the lottery consisted of forty thousand shares of ten shillings each. Any profit that might arise was to be devoted to the reparation of harbours and other public works.

The city of Lyons consumes annually two million pounds of spun silk. Four cocoons and a fraction are necessary to produce a gramme—(the five hundredth part of a pound), consequently, the consumption of Lyons alone requires 4,200,000,000 cocoons; the length of silk thread in each being about 500 metres, the total is equal to 2,100,000 millions of metres, which is fourteen times the distance of the earth from the sun, or 5,494 times that of the moon from the earth. That length would encircle the globe at the equator 52,505 times, or reach 200,000 times round the moon.

Mahanama, who wrote his history before A.D. 477, mentions that Sanghatissa, King of Ceylon, who was poisoned A.D. 246, placed a pinnacle of glass on the spire of Ruanweli Dagobs, to serve as a protection against lightning.

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SUBMARINE TELEGRAPHY.*

IV.

SHALLOW AND DEEP SEA CABLES (*continued*).

Table VI. shows the strength of iron and steel strands wrapped with Russian and Manilla hemp, and with ¾ lay and 1¼ lay respectively; also the strength and stretch of the separate materials. It will at once be seen that a difference of lay produces an extraordinary augmentation in the breaking strain and in the elongation. The stretch of a wire when approaching its breaking strain is concentrated nearly at one point, where it rapidly diminishes in diameter. The effect of the hemp is to support the wire at a number of successive weak spots of this kind, and thus greatly to augment the elongation before breaking; but it will further be observed that the breaking strain of the combined materials is actually greater in some cases than the sum of the strengths of the separate materials. Thus the sum of the manilla and steel, taking the mean strength, is a little less than 12 cwt.; but the mean of the combined strand is more than 12¼ cwt. With Russian hemp the sum of the separate strengths is 11·07 cwt., but the combined strand supported 11·42 cwt. The results with iron do not show this anomaly, but the apparent paradox with steel wire has been fully confirmed by independent experiments made for the Atlantic Telegraph Company. The explanation is, that when tested separately we have the strength of the weakest points, or smallest sections of the wires and strands; but these materials are never uniform, and when combined, as it is most improbable that the two weakest points should coincide, we obtain the sum of their mean sections or strengths. The cables formed by these hemp-covered steel wires are very strong. Table IV. shows that the Atlantic cable, relatively and absolutely, is the strongest cable yet made, bearing more than twice as great a length of itself as the old iron cable. The new form stretches more than the old. The hemp may be eaten off, or decay from the wires, weakening the cable, and the hemp affords less mechanical protection against injury; but the stretch is never such as to endanger the core, as has been proved by repeated experiments, and the most serious defect of the cable is probably its expense.

9. *Proposed forms of Deep Sea Cables.*—Rowett's hempen rope could certainly be laid. The lecturer has had no sample of it, but fears it would be extensible. Allan's cable could also be easily laid, so far so as its strength is concerned. It is said to coil badly; but the lecturer has not seen this tested. The proximity of the copper and steel inside the cable might cause the steel to rust and burst the core. Still it is desirable that this form should be practically tested. Mr. Siemens' cable mentioned in table IV., will be found described in the appendix to this lecture. The stretched hemp has great strength, and elongates little, but has to carry an immense load of copper, which does not add in the strength of the cable. The phosphorised copper sheathing would probably be very permanent. This cable has actually been laid and is now working. A trial of it was not successful in deep water, but a piece was recovered from 1,600 fathoms. Duncan's cable, covered with plaited ratan, is too extensible, and the ratan, though durable in water, does not add much tensile strength. The lecturer has had a sample of cable made, in which he used Siemens' stretched hemp, covered with Duncan's plaited cane. Its properties are given in table IV., and its specification in the appendix. This cable combines great strength, small elongation, lightness, and cheapness. A bare gutta-percha core could be laid easily, but could not be recovered from great depths.

10. *Statistics of Deep Sea Cables.*—Excluding the 1,000 miles in abeyance under the Atlantic, and the cable lost in the first experimental trips in the Atlantic, only some 500 or 600 miles of cable have been lost during laying. About 9,000 miles have been laid and worked a little while, but are no longer working. From 700 to 850 miles are now at work, but much of this is in no great depth. The Barcelona Mahon cable, believed still to work, although faulty, is included in this list. There is but one quite sound cable lying at work in more than 1,000 fathoms, viz., that between Sardinia and Sicily, 243 miles long. One section of the Malta-Alexandria cable is in 420 fathoms, and has never shown any deterioration. The probable causes of failure have already been enumerated.

11. The general conclusions to be drawn from the statistics given in this lecture seem to be, that in shallow seas, by laying heavy strong cables we can ensure, and have obtained, success, both from an engineering and commercial point of view; that in deep seas we have hitherto failed, but that success is not unattainable, and may probably be reached by various methods. The lecturer believes that while in shallow seas, where repairs are possible, cables can hardly be laid too heavy or at too great an expense, in deep seas, where repairs will always be precarious, they can hardly be laid too light or too cheap.

APPENDIX I.—*Specification of Cables in Tables.*

1. First Atl ntic:—Core (*vide* Table III.), covered with 18 strands of 7 bright best charcoal wires 0·028 in. diameter, called No. 22. Total diameter 0·62 in.; weight of iron, 15·64 cwt. per knot.

2. Red Sea:—Core (*vide* Table III.), covered with 18 bright iron wires (? charcoal), called No. 16, B.W.G., diameter, 0·077. Total diameter, 0·56 in.; weight of iron, 16 cwt. per knot.

3. Malta-Alexandria:—Core (*vide* Table III.), covered with 18 bright charcoal iron wires, each 0.12 in. diameter, called No. 11 (?). Whole cable, 0·85 in. diameter; weight of iron, 33·56 per knot.

4. Persian Gulf:—Core (*vide* Table III.), covered with 12 galvanized iron wires, 0·18 in. diameter, called No. 7½ (?); diameter of iron cable, 0·9 in.; covered with hemp and bituminous compound to 1·25 in. diameter; weight per knot of completed cable, 3·7 tons.

5. England-Holland main cable:—Ten black wires, 0·375 diameter, called No. 00; external diameter 1·58 inch; weight per knot, 10·4 tons; shore end 15 wires, 0·22, called No. 5, covered with 12 strands made of three wires of same diameter, covered with Bright and Clark's Composition to 2½ inches in diameter; diameter of iron two inches, and weight per knot, 19 6 tons.

6. Toulon-Algiers:—Core (*vide* Table III.) covered with 10 steel wires, each enveloped in four strands of Russian hemp; diameter of steel wires, 0·08, called No. 14; diameter of strands about 0·2 in.; weight of hemp in strands (?); diameter of completed cable, 0·8 inch; weight in air, 1·31 tons.

6. Steel and hemp coated Gibraltar (proposed):—Core like Malta-Alexandria, covered with twelve steel wires in four hemp strands. Diameter of wires, 0·08; weight of steel per knot, 10 55 cwt.; of hemp 6 cwt.; lay of hempen strands, 1¼ inch; diameter of completed cable, 0·875.

7. Iron and hemp-coated Gibraltar (experimental):—Like No. 6, with iron instead of steel.

8. Second Atlantic Cable:—Core (*vide* Table III.), covered with ten steel wires each in five Manilla hemp strands; diameter of each wire, 0·095 inches, called No. 13; diameter of strand, about 0·28 inches; weight of hemp strands per knot, about 12·8 cwt.; lay of hemp strands, three inches. Webster and Horsfall's homogeneous steel; diameter of completed cable, 1·125; weight of steel per knot, about 13·75 cwt., and the serving round core about 2·2 cwt.

9. Siemens' copper covered cable:—Sample in Table V. Copper conductor, 550 lbs per knot; insulator, 420; diameter of core, 0·52 in. Stretched hempen strands, 440 lbs. per knot; copper armour, 675 lbs. per knot; diameter of completed cable, 0 75 in.

10. Allan's cable:—Sample in Table V. Solid copper conductor, 0·114 in., weighing 240 lbs. per knot; surrounded by 19 steel wires, 0·02 in. diameter weighing 120 lbs. per knot; diameter of steel strand, 0·16 in.; covered with 300 lbs. of gutta percha, diameter 0·456, and canvas web; total diameter, 0·522.

11. Ratan and stretched hemp (sample in Table V.):—Core, 3·63 cwt. per knot; diameter, 0·34 in.; covered with fifteen hempen strands, weighing 1·84 cwt. per knot; and covered with plaited ratan cane weighing 1·84 cwt.; total diameter, 0·625 in.

* Lecture II.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, February 5.

TABLE VI.

Compiled from App. 10 to the Report of the Joint Committee on Submarine Cables (Gisborne, Forde, and Siemens).

MATERIALS.	BREAKING STRAIN IN CWTS.			ELONGATION IN PER CENTAGE OF LENGTH.			
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	No of Experiments.
Steel wire 0·079 in. diameter	8·50	8·00	8·20	1·80	1·00	1·41	5
Iron wire 0·079 in. diameter	4·50	4·18	4·35	0·72	0·46	·55	7
Steel wire with 4 strands of Manilla hemp — ¾ in. lay	9·25	9·25	9·25	1.77	1·77	1·77	3
Steel wire with 4 strands of Manilla hemp — 1¼ in. lay	13·00	12·12	12·59	3·12	2·32	2·63	6
Steel wire with 4 strands of Russian hemp — ¾ in. lay	10·0	9·50	9·70	2·18	1·80	1·76	3
Steel wire with 4 strands of Russian hemp — 1¼ in. lay	11·75	10·87	11·42	2·70	2·28	2·45	5
Iron wire with 4 strands of Manilla hemp — ¾ in. lay	4·75	4·50	4·62	0·79	·47	0·63	3
Iron wire with 4 strands of Manilla hemp — 1¼ in. lay	8·50	8·12	8·28	2·80	2·56	2·62	4
Iron wire with 4 strands of Russian hemp — ¾ in. lay	5·00	4·75	4·87	0·92	0·66	0·82	3
Iron wire with 4 strands of Russian hemp — 1¼ in. lay	7·43	5·00	6·2	2·46	1·04	1·82	6
Manilla hemp weighing 0·05 lbs. to 0·0615 lbs. per fathom	3·87	3·62	3·75	...	...	2·62	2
Russian hemp weighing 0·41 lbs. to 0·45 lbs. per fathom	3·50	2·25	2·87	1·60	1·00	1·30	2

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PERSPECTIVE IN ITS APPLICATION TO ARCHITECTURAL DESIGN.*

I.

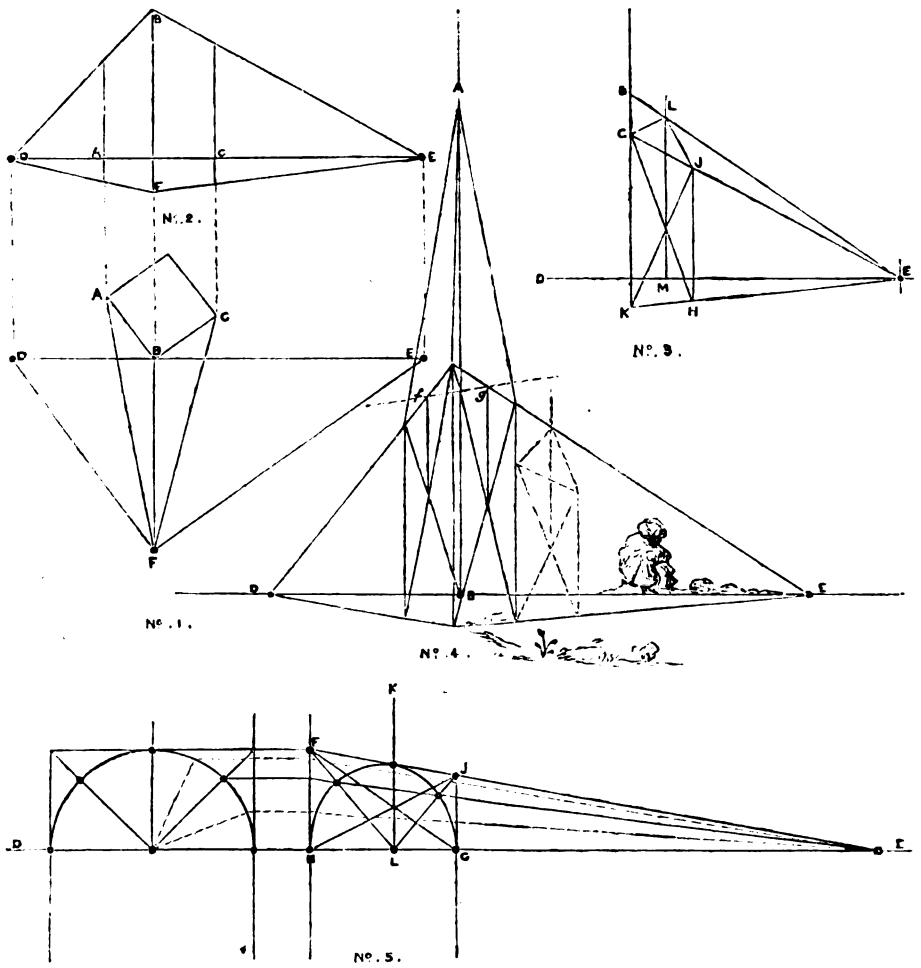
In the following remarks I do not intend to fatigue you with a series of scientific technicalities, but I rather desire to lay before you the results of experience and such practical rules as you will for the most part find useful and sufficient for all ordinary purposes. Nor is it needful for the purpose in view to enter into an abstruse mathematical investigation of the science now under our consideration; that part of it is not only very unentertaining to those who have not advanced far into it, but unnecessary. I shall therefore endeavour to explain in a manner as easily to be understood as possible, and by as few rules and examples as will enable you to consider your work in its true bearings in reference to such buildings and other objects as are generally met with in practice; and, by impressing on the mind general principles with the aid of a few hasty diagrams, I hope to be able to make myself sufficiently understood for all practical purposes.

I will here remark that some knowledge of the anatomy of the eye is of great interest and value to the student, as from it the theory of perspective is deduced, but for the present purpose it will be sufficient to bear in mind that all objects of whatever outline and form give off or reflect the rays of light in straight lines; these visual rays are represented by lines supposed to be drawn from the object to be represented on paper to the station point, that is, the eye of the spectator; and if we suppose a horizontal line of indefinite length to be drawn through that point we shall find that all the horizontal lines of the object appear to converge to two points in that line, one on either side, and then to vanish, whence these points are called the vanishing points. Bearing in mind that the horizontal line is always at the exact height of the eye of the spectator, whether he be standing on the ground or raised above, on the top of a house, a tower, or hill. On the application of these facts depends all perspective when considered in connection with the vertical and perpendicular lines of the object.

If the object to be drawn be an existing building for instance, the eye will give with more or less accuracy the points to which its horizonal lines vanish; but if, as is the case to which our attention is chiefly directed, the building to be drawn only exists on paper, the process to be followed is simply this—take the plan of the building or thing to be drawn in perspective and assume the position from which it is to be viewed, that is, fix your station point, draw lines from the extreme angles of the building to that point, which is that of the spectator, and also a line from the nearest angle to the same point, draw a line perpendicular to the last and continue it indefinitely on each side; finally, from the station point draw a line parallel to each of the visible sides of the building and the points of contact with the perpendicular line will be the vanishing points of the respective sides.

In the diagram (No. 1) A B, B C are the sides of the building, A and C its extreme angles, B its nearest angle to the station point F, D F and F E the parallels to the two faces of the building A B and B C, D E the vanishing points on the perpendicular line to B F.

If the building have a rounded angle, or is cut away, or indented at the angle, the two sides may be produced until they meet, and the problem then become the same as for a right angle, and so for every modification between it and a close approximation to an actual curve, keeping in mind that the vanishing points in every case must fall on the horizontal line.



We will now consider the diagram already described in its relation to the elevation of the building proposed to be put in perspective; upon the horizontal line we will suppose a point which we will call the point of sight, or that corresponding with the angle B in the diagram No. 1.; across the horizontal line at the point nearest the eye of the spectator or station point draw the perpendicular F B (diagram No. 2), taking care that the intersection of two lines shall be the proper height above or below the base of the building in reference to the position from which it is seen, then from the top and bottom of this line draw two other lines to the vanishing points D E corresponding to the top and ground line of the building, upon these two lines again mark off with perpendiculars the two sides of the building or extreme angles A C, and the result will be B F, the nearest angle to the station point or spectator; A C, the most distant angles; B E F and B D F, the top and bottom lines in their respective angles in relation to the vanishing and station points, so by this operation the object given by plan in diagram No. 1 will have been put in perspective. And, supposing there are several buildings or parts of one building of the same or similar size, mark them off with other perpendicular lines to the horizontal line, as in the first instance; if there are windows or other openings to be shown mark off the space the first ones occupy, and by lines drawn from the bottom and top of each kind to the vanishing points we get them all the same perspective height and proportion throughout the entire work. Thus one of the sides of the building will have been represented, and the same process must be followed for its counterpart.

We will now suppose it is required to raise a gable or pediment, and in order to do this correctly we must first find the true perspective centre of the side of the building upon which it will stand; for this purpose it is not necessary to refer to the plan (diagram No. 1), indeed, I would in most cases advise you to avoid doing so, because you can obtain the same results with equal accuracy in a less roundabout way. First draw two diagonal lines, one from each corner of the building, G H and I K, from the ground to the top, and then where these two lines intersect, draw a perpendicular, L M, indefinitely, and by setting off the proposed height on the produced line, B, or nearest angle, and drawing a line from it to the vanishing point, E, its point of intersection with L M will give the true perspective apex and shape of the gable; and it may be remarked here that this simple rule is of the utmost importance, for many of our greatest painters appear to have been quite unaware of it, and made, consequently, many very ludicrous mistakes, for you will find by referring to many of the works of Teniers, Albert Durer, and several others, that they scarcely ever drew a gable end to a house, and that they did not put it off the centre, either leaning too much to one side or the other, giving the idea of falling, which no doubt they never intended. It does seem certainly strange that men so gifted should have made such oversights, especially as in some instances they are so glaring that they create a feeling of pain in the mind of the observer, who is frequently drawn aside from the contemplation of their exquisite drawing and colouring by being compelled to fix his eyes upon what cannot be felt to be other than a great blemish; and yet it appears to be an error that almost all unacquainted with the rule are liable to fall into. You will see, therefore, that I am right in endeavouring to impress this very simple rule upon your minds, and in order to carry out the idea still more fully we will take as another example, a square tower with a spire, in which case the violation of the rule would be worse if possible than that of the gable; suppose then that diagram No. 1 is the plan of the tower, we

* Paper read to the Class for Architectural Study, Royal Institute of the Architects of Ireland, on the 11th ult., by E. Trevor Owen, Fellow.

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will commence by marking off the height on the nearest angle as in the last case, drawing the horizontal lines to the vanishing point as before, through the perpendiculars of the two extreme angles, and having drawn the diagonals on each face as before described, the point of intersection gives the perpendicular centre of each face of the spire (presuming it to be a square one), and the perpendicular line A B (diagram No. 4) half way between the two extreme angles of the tower will pass through the apex of the spire; and should it be required to find the vanishing lines of each face of an octagonal spire without complicating our work by referring to the plan, the lines so required will be obtained by joining the two points *f*, *g*, representing the centre of each face of the square spire already described; and this principle will hold good if applied with a little care in finding the lines required for each of the other sides of a polygonal figure of almost any form.

Another matter worthy of remark is the difficulty of drawing the arch in perspective, even when the true centre and size of the opening may have been obtained; but for almost all practical purposes I have found the following rule to suffice. Presuming the arch to be a semi-circular one, draw its width and height as if treating a rectangular figure; then, finding its true perspective central line by the diagonals, F G, H, I, draw the perpendicular K L, and from the point of intersection with the springing line, assumed to be also on the horizontal line, draw other diagonals L F and L I, which will pass through the shoulders of the arch at points dividing the curve into four equal parts, and when the true geometrical form of the arch has been ascertained and laid down as a guide, almost any number of points in the curve may be obtained by increasing the number of the diagonals with sufficient accuracy for all practical purposes; and this rule with slight modifications may be applied to arches of almost any form.

THE LATHE AND ITS USES.*

VIII.

We shall now proceed to give some examples of turning different things which are useful and interesting to work. These are only hints, and we make no claim to discovery, or to anything specially novel or ingenious. It would be very foolish to do that, for what seems remarkably "cute" to the designer of any particular thing, is often shown to be slow and unmechanical, compared to other ways by other men. We hope, therefore, that the expert will bear in mind the fact that, while he may know better ways to do the same thing, beginners are glad to receive instruction first, and improve upon it so much as they are able after.

TO MAKE A PAIR OF SOLITAIRE SLEEVE BUTTONS.—*Solitaire* buttons are those which have so lately come in fashion; that is, a single stud with two eyes on the back for the button-holes of the wristband. It is easier to make one stud on the back of the button, and easier to fasten it to the shirt, as that is the kind we shall describe.

Go to any dealer in box-wood and procure waste stuff, which he will sell at a small price. Take a piece an inch square, put it in the chuck, and turn it round on one end as far as you can, then reverse it, and turn the other end; this will make a round plug. Take a ten-cent. piece, and chuck it, either in a wooden or scroll chuck. Cut out the centre so that you have a silver ring. It will be necessary to have two rings, one for each button. Put

FIG. 34

FIG. 35.

the box-wood in the lathe and turn the end, as in Fig. 35. On the shoulder you are to shrink the silver ring just made. To fasten the ring properly you have only to leave the centre part of the box-wood a little larger than the silver ring—say the thickness of a sheet of paper—heat the ring slightly on a stove or over a spirit lamp, and clap it on to its place. When it is cool, if properly done, no power can remove it without destroying the button. When the ring is in place it only remains to turn it off as ornamentally as the workman desires. The edge may be milled and the face chased or left smooth. The centre of the button, which is of wood, may be drilled in, and a square ebony plug put in, which will give it a unique appearance, as shown in this figure. In like manner ivory buttons may be turned and breastpins spun up either in gold or silver. Brass breast-pins may be ornately turned and afterward electro-plated for a trifle. They will thus be cheaply made, and the ingenious turner can please his lady friends by presenting them with specimens of his dexterity and taste.

FIG. 36

At the commencement of this series of articles we alluded to lathes with traversing mandrils, and to varieties of work done by tools not generally employed—that is, those which are not used by the hand, but in connection with the lathe, and driven by belting from a counter-shaft overhead. We give an illustration of such a tool in one form in Fig. 37. It

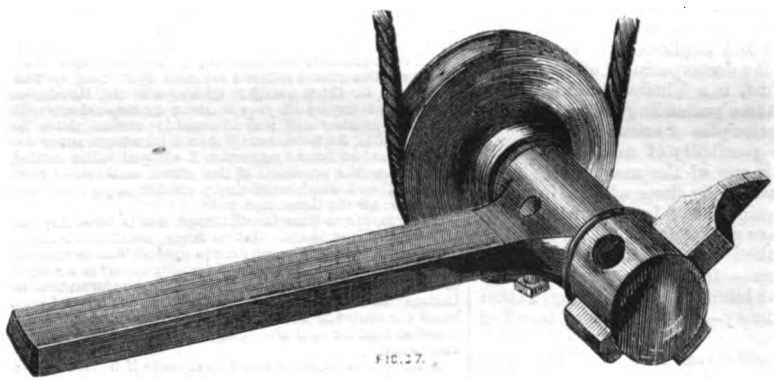

FIG. 37.

may be screwed in the tool post of the slide rest, or otherwise attached to the lathe, and the belt from the counter shaft carried over the small pulley. The driving pulley overhead should be very large, so as to give a great velocity to the cutter, at least 1,500 revolutions per minute. The use of this tool is to make ornamental designs—circular carving it might be called—on all kinds of turned work, as, for instance, in this figure, where a small

FIG. 38.

box for pins or needles is shown. This box is made by putting a piece of hard fine grained wood in the chuck, boring the hole and cutting the thread. It is then removed, driven on a round mandril held in the chuck, turned off round outside, and then prepared for the pattern as follows:—The design settled upon, the index plate must be brought into use, and the points inserted in such holes as will bring the pattern out right or all the spaces equal—just as the teeth of gears are cut. The tool shown in Fig. 37 may be any desired shape. In the example of work, Fig. 38, it is made half round, and the pattern is called "bamboo," from a resemblance to wicker-work. The pattern is made to break joint, as mechanics say, that is it alternates, so that the commencement of one part meets in the middle of the other. After one course is made all the way round, the tool is shifted on to another course, and the index changed as above mentioned until the whole has been gone over. This produces a beautiful effect.

It is easy to see that a change of pattern is produced at will by altering the kind of tool and the index. As, for instance, in this other figure—

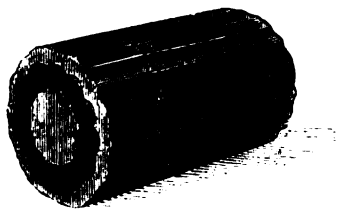

FIG. 39.

where the pattern is entirely straight. When the design is to be cut on such work it is extremely convenient to have a pair of centres to set on the lathe across the bed; then the flying tool is not needed, nor the index on the lathe pulleys either, that on the centres being used instead. When this box is held between the centres so as not to mar it, the handle may be turned and the work run along under the cutter with great facility. The grooves shown in the box are first drilled at each end with a common drill just to the corner of the drill, so that a neat and handsome finish is given; a V-shaped cutter is then put in a mandril between the centres of the lathe, and the pulleys set going, so that when the work is run under the tool, the slot or groove will be formed. The circlet at the top of the box is made by a crescent drill ground very thin and made sharp—a drill like a fish's tail, only formed on a half circle.

Of course these methods of doing this kind of work can, as we have said before, be varied infinitely, and are only cited as applicable to a common foot lathe.

* Mostly compiled from the American Journals.

HEAT AND MOTION.

A remarkable instance of the conversion of mechanical motion into heat is recorded in the *Proceedings* of the American Academy of Arts and Sciences (Boston). A turbine working in a race led from the Merrimac river, and supplying the motive power to one of the Lowell cotton factories, was observed to be irregular in its motion. On examination it appeared that the "steady-pin," at the lower end of the shaft, made of steel two and a half inches diameter, and working in a box of case-hardened iron, was actually fused, although it had been constantly plunged in the race, through which seventy-five cubic feet of water rushed every second—4,500 feet per minute. The pin and portions of the iron box were exhibited at a meeting of the Academy, and on each the signs of fusion were clearly apparent. The moving power of a turbine is known to be great; but here we see it converted into heat, which, in defiance of the rapid stream of water, rose to the temperature of the welding point of iron. That heat is but a mode of motion is a question that has worthily occupied the attention of Dr. Joule and other mechanical philosophers, and to them we commend this new and striking illustration.

WATER at the temperature of 0 degree Cent. when absorbed by snow, is lowered in temperature.

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WATER AS FUEL.

The possibility of using the gas obtained when water is decomposed by means of heat has long been a subject of dispute, and a great deal of time and money have been wasted in researches regarding it which science teaches us are vain. Without entering into the reasons, we may safely assert that there can be no well-grounded doubt that it takes at least as much heat to decompose water as is given out during the combination of the gases which constitute it. Where, therefore, can be the saving, in ordinary circumstances, when the decomposed vapour of water is used as an aid to the power of the fuel? We say, in ordinary circumstances, since there are cases in which the gases obtained by the decomposition of water may, by their combustion, indirectly lead to economy of fuel. Thus, when anthracite is burned in the furnace of a steam boiler, the heat is very intense within a small space; and it not only rapidly destroys the fine-bars, &c., but, from want of diffusion, does not impart the heat economically. The introduction of steam into the burning fuel is, to a greater or less extent, a remedy for this. The decomposition of the vapour of water moderates the intensity of the combustion, and the heat absorbed by the gases liberated is given back again in places where little effect would have been produced by the anthracite itself. In a word, some of the best properties of bituminous coal are, in this way, imparted to the anthracite. All this is easily understood—there can be no mistake on the subject: there is no augmentation of heat, but merely a more useful application of it. Where this is not required, the expectation of economy from the decomposition of water, as a means of saving fuel, is a delusion; and one that is inexcusable in those pretending to a knowledge of even the first principles of science.

A belief in the possibility of using water as an auxiliary to fuel, is one of the many examples of self-deception practised by those who are in search of physical impossibilities. In such cases, very plausible results are put forward; but an examination would show that, were the inquiry conducted with sufficient care—and not, as in too many instances, with the intention of confirming, rather than testing, a theory—they are not to be relied on.

The Cooper Institute of New York has been recently occupied with a discussion on this subject. Dr. W. E. Hagan, of Troy, had made experiments which he considered went to prove that his theory regarding the use of decomposed water vapour, as an aid to combustion, was correct; and a committee was appointed to test his plan; but reported that the experiments were not sufficiently exact to enable them to come to a decision—just the usual fault of experiments in such cases. Comparisons had, however, been made between the quantities of water evaporated by fuel alone, and with the aid of decomposed watery vapour; and, according to the chairman of the committee, these appeared to show that the evaporation in the former was to that in the latter case as 50 to 75. Without denying the accuracy of these results we have no hesitation in saying that any advantage which may really have been gained, must have been due, not to augmentation of the heat evolved, but to its better application.

There can be no doubt that the subject is, at present, attracting considerable attention in America; and it was stated by Dr. Hagan that a locomotive on the New York Central Railroad, to which his principle had been applied, was evaporating 30lb. of water with one pound of coal. The same company were also said to be applying his principle to six more of their locomotives, and to be about to construct twenty others, in which it would be used. Notwithstanding all this, it remains to be proved by unexceptionable experiments that an *increase* of caloric is obtained. We do not believe that it is; for we hold it to be an undoubted law that "as much heat is required for decomposition as is evolved by subsequent recomposition."

It is estimated that 18,000 elephants are yearly killed to supply Sheffield alone with ivory.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

THE CARBON CUTTING QUESTION.

Sir,—It has been rendered patent to the world through the medium of your estimable and ably conducted journal that one Mr. Peter Henderson makes a casual tour through the wards of London, and in second-hand shops occasionally strikes a bargain, and hence with the most "reticent prudence" jumps to the conclusion that every one can do the same, in fact, wonders where amateurs were born if they can't "strike lle" any day. Very pretty in print, but what are amateurs?—and have we a right to expect to find in them the "profound and practical acquaintance" upon any given subject that we should look for as inseparable from the man practically and solely engaged on such subjects? Certainly not; and yet occasionally we find these amateurs outstrip their very practical compeers, by devoting a little time to the science as well as the practice of any given matter.

There are amateur electricians at present all over the world, and I hope the readers of your journal are co-extensive with them, and when Carbon asked for information I gave it him freely, as I myself received it, in years gone by, and I did not recommend Mr. Peter Henderson's establishment, simply because I did not know of its existence, but I knew where to get carbon, good and cheap, and there I sent Carbon; at least, I hope so, if he does not wish to be disappointed. So much for the insinuation; now for the assertions made, or so broadly assumed, that those of your readers who have little leisure might take them for granted.

For their information, as well as that of Mr. Henderson, I beg to say that my carbon-block cost 9d., my tenon saw cost 2s. 6d., fifteen years ago; it then had a blade 12 in. long by 3 in. wide, and after during that period performing all the services to which I have had occasion to use such an implement (the carbon cutting included), it is now sharpened and re-set, and measures exactly 12 in. long by 2½ wide, so that if I had used it for nothing else we could only tax the carbon with 1-5th of the original cost, 5d. It took two hours early one morning to cut the single block into six plates (those referred to) each 4½ in. long by 2 in. wide, by ⅜ in. thick nearly! Query, will Mr. Henderson undertake to supply all your amateur correspondents with the same number and size of genuine carbon plates for the sum of 1s. 2d.?—because I do not (amateurs never do) include the two hours' recreation I enjoyed while cutting them, since the prevision of the effects anticipated from their use, and which were amply verified in practice, well repaid me for the time employed.

There is, Sir, a time for all things, nor is there any the less a place for them. But to fancy a self-called super-practical man imagining anyone to suggest that an amateur should cut carbon plates in a "drawing room" is a stretch of the imagination that no words in my information to Carbon could be stretched to, however elastic; hence I must hand the sentence back to Mr. Henderson under the impression that he used the phrase because he had nothing else to say.

What Mr. Henderson would have done if he had known how easily carbon could be cut to serve the amateur's purpose, or what expenses he might have avoided in the way of machinery is no affair of mine. I dare say if the late Atlantic Telegraph Company had known that the cable would break just where it did, they would not have commenced to lay it; but they did not, and yet they do not talk quite so dogmatically as Mr. Henderson, who seems to think that no one beyond the boundaries of Clapham knows what carbon is. Resting upon my oars for a moment, let me enquire, does he know? He says a cinder snatched from the grate is carbon. I deny it, and leave the onus of proving it with him, among your chemical readers.

Could he use it as a conductor with electricity of such a tension as is generated in a Bunsen's battery? A thousand times NO! and yet he steps forward to complain that "amateur gentlemen scarcely exercise that reticent (?) prudence which a more profound and practical acquaintance with their subject would surely suggest." If, Sir, you are content, I am equally so to lie under the provisional onus of being one of these incapables until the article promised by Mr. Henderson noted in your "Answers to Correspondents" appears, as we may then hear something of the true ring of the metal that is in him; in the meantime I can only recognise him as I would the fly on the axletree; he has been visible but has not raised all the dust.

In reply to W. J. F., the dimensions previously given in this letter show what the carbon negatives are; the zincs are of No. 12 Bham. W. G., 8 in. long by 4 deep, bent into the form of a U whilst hot. An ordinary porous cell goes inside this (obtained from Knight's, 2, Foster-lane, London); a slip of copper is tinned to this for connection. Zincs well amalgamated, connection with carbon is made, as I once or twice before stated, by a brass clip, between which and the carbon small pieces of platinum foil are inserted to keep the brass from the direct oxydizing influence of the nitric or nitrous acid, which rises up through the carbon by capillary attraction. By this means you always secure good contacts, a matter of the highest importance, especially when using such agents as nitric acid for an exciting or conducting fluid. In the porous cell where the carbon is placed I use half nitric to half sulphuric acid, in the outer or zinc cell I use 1 sulphuric acid to 7 water. I make my binding screws and clips of brass, but I have seen some very good results obtained by making them of ordinary brass wood screws with gutta percha heads, having previously square blocks cast in lead upon them, and then the screws and heads coated with copper by electro deposition. Of course, I would not recommend "An English Mechanic" to adopt such barbarous means to attain an end, but I have seen it done by one who was no mechanic (in the ordinary sense of the term), but who has done as much for electricity, as a science, as perhaps, any man living. He had not the tools, but he had the genius to see how they could upon occasion be dispensed with. And such is the fate for the most part of all amateurs. When I address you it is as a fellow working man. Had we all Fortunatus' wishing cap in our possession (would there be any English mechanics in the country?) should we not each just pop it on and wish, and have! We have not got such things, but we have brains, muscles, and sinews, which, rightly used, lead us directly, yet not without opposition occasionally (and 'tis well for us 'tis so, now and then), to the one great goal, "perfection," so far as it is attainable by human beings.

Wm. Tonkes.

CARBON PLATES.

Sir,—In your issue of January 26th, I made an enquiry respecting the formation of carbon for batteries, which was kindly answered by some of your correspondents, including Mr. Tonkes, on whose suggestion I have acted with the most desirable results. I have cut many most excellent "Carbon Plates," of all sizes, from rough blocks given to me by the engineer to our local gasworks, who also uses the same material for a very powerful battery himself.

In your issue of February 23rd, I find a letter from a London Optician, who deals in carbon, and as the writer runs a tilt at Mr. Tonkes, which might tend to discourage that gentleman or other correspondents, I feel myself bound by the laws of chivalry, to try a lance in his defence.

I will so far render an account of my experience, which dates from the tutelage of "Sturgeon," as to say that for a long time I have been using electric and voltaic apparatus, and on a recent occasion I used a "Bunsen Battery," for eight weeks in public, of course with the necessary attendance, with carbon plates supplied by a leading electrician, but I find the plates cut by myself, and also points for the electric light, and which I recently used at a public lecture given by me, are equally as good and in some respects better, than I have ever yet used, being close, compact and dense. ("*not compressed*"). I write on the presumption that there is but "*the*" Gas Carbon, of the gas retort.

In conclusion, if Mr. Tonkes will only state the dimensions of say half a dozen plates, such as would be useful to him, I will cut and forward them to him free, as a specimen to judge by, and an acknowledgment that his kindness is appreciated by

Carbon.

CARBON CUTTING.

Sir,—Having noticed Mr. Henderson's article on the cutting of "carbon," I can fully substantiate his remarks from my own experience, viz., fourteen years. I would strongly advise all amateurs to purchase their "carbon" ready cut, otherwise they may find it rather more difficult than they imagine.

Electrician.

SHEFFIELD GRINDERS AND OTHER UNHEALTHY TRADES.

Sir,—Amongst the many unhealthy employments of working men, undoubtedly the most injurious of all is that of the "Sheffield grinder;" this unhealthiness arises from the millions of fine particles of steel dust, which are constantly flying through and impregnating the atmosphere of the workshop, and are inhaled both through the mouth and nose of the grinder, and of all who are employed in the shop. This dust insinuates itself into the air vessels, which in time become partially filled with it. The consequences are inevitable: a constant irritation of the lungs; the well-known "grinders cough;" spitting of blood; a constant metallic taste in the mouth, which necessarily destroys all relish for food; it takes complete possession of the man's system; disturbs his sleep, haunts him night and day, and destroys his peace of mind and his life at the same time; under these disadvantageous circumstances, the thoughtless man flies to drink; and in scenes of dissipation endeavours to forget his troubles. The result invariably is death at an early age.

The question at once suggests itself, "But is there no remedy for this?" The answer may be as quickly given, "Yes, many remedies, but—strange to say—none are adopted." Although it is well known that by the use of the rotating fan a violent current of air is created, and that this current will carry all the particles of steel dust through a tube fixed near the wheel, yet, strange infatuation, not in one case out of a hundred is it used; the workman says forsooth, "It is a somewhat expensive apparatus, and he cannot afford to procure it—and stranger still—the master seems to care so little for the health of his men, that he will not provide it.

Where such shameful apathy and carelessness can exist on such a vital subject, it seems a hopeless and indeed a thankless task to suggest or introduce a new remedy; yet with this forlorn hope and at the risk of being thought unnecessarily anxious about those who have no anxiety for themselves, I beg leave through your columns to call the attention not only of the Sheffield workmen, but of all who are employed in other such unhealthy trades, to a very cheap and simple contrivance, by means of which they may avoid such inhalations, and which only requires a trial to prove its usefulness.

My attention was forcibly drawn to the subject by the discussion at the meeting of the Social Science Congress at Sheffield, and having had some experience in the manufacture of respirators, I applied myself to—and I believe I have succeeded in—the production of an orinasal respirator (to cover both the mouth and nose) which shall not be unsightly or clumsy, and which shall be simple and efficacious.

The oral respirator is constructed with two oval thin plates of perforated zinc or non-corrosive metal, about 3½

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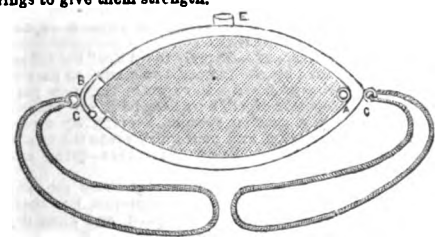
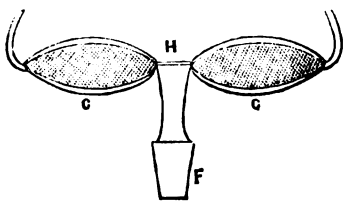
inches long, and 1½ broad, having the edges turned over, and covered with a binding of velvet all round, so as to fit closely and present a soft surface to the skin and the mouth; the number of perforations varying from 20 to 25 per square in h, according to the size of the holes; better than metal plates (but perhaps not so easily obtained) are two pieces of fine wire gauze, either silver-plated or gilt, sizes as above, and with the edges turned over oval wire rings to give them strength.



These plates are connected at one end A by a rivet hinge, at the other end B, by a clasp (similar to a purse clasp), so that the plates may be separated for the purpose of cleaning them, and for inserting between them a thin layer of mohair, alpaca, or fine horsehair fabric, to act in conjunction with the metal plates as a strainer; these may be removed when dirty, and cleansed, or replaced by a fresh layer of fabric. Attached to each end of the respirator is a small metal ring, to which are attached elastic strings, which loop over the ears, and keep the respirator close over the mouth.

The nasal respirator is formed by attaching to the inner edge of the under plate at E, a socket, into which slides a piece of watch spring F (so as to be removable at pleasure), shaped and bent so that it will fit close to the groove of the upper lip, and well under the nose; to this spring is attached crosswise at H, two oval rings, G, S, just the size of the nasal orifices; these also are covered with two



layers of silver plated gauze, and this again covered with mohair, alpaca, or horse hair; they then present very much the appearance of a miniature pair of wings. These, when properly fitted, effectually act as a strainer, through which no foreign matter can penetrate.

I have thus endeavoured to describe separately the oval and the nasal respirator—the two fitted together, form, I think (and several medical gentlemen to whom I have submitted the idea, agree with me) the *sine qua non* of a cheap and simple oral-nasal respirator; and such a one that any workman of intelligence may make for himself. Should any of your readers who feel interested require any information or further guidance in the construction of such an instrument, I shall be most happy to supply it.

J. J. HARVEY.

19 Brook street, Regent's-park, N.W.

COMBUSTION OF GAS.

Sir,—Will you kindly allow me to return thanks to the five gentlemen who so promptly answered my query (relative to the combustion of gas in the Argand lamp) which appeared in your issue of Saturday, 19th ult? Thanks to their hints and your kindness in inserting the answers, I have got rid of the smoke. JAS. ROBERTSON.

BOWDITCH'S IMPROVEMENTS IN GAS LIGHTING.

Sir,—In reply to your correspondents, I have to state that the Rev. W. E. Bowditch's Improvements in Gas Lighting are protected by two patents, the first one taken out in 1862, the last in 1865. W. J. BAKER.

Offices, 15, Westgate, Wakefield, Feb. 23, 1866.

SUBMARINE TELEGRAPHY.

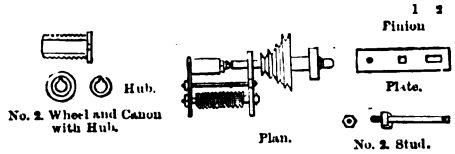
Sir,—A few weeks since your very excellent paper contained an elaborate illustration of Mr. Van Choate's scheme for a Submarine Telegraph. I consider the idea a very good one, but as an amateur, I would suggest that instead of having in the centre of the ocean a machine which in the course of time must get out of order, that the batteries at both ends should be in connection with each other at the same time, thus the battery on the American shore would help the English one. Instruments could be easily arranged at each end to bring the batteries at the opposite ends into action when required.

Suppose, for instance, the clerk at the English station wishes to communicate with America, the clerk at the American station, understanding the signs, may put his battery in circuit with the cable and earth, and thus the English clerk will be working both batteries. Of course, this arrangement, as well as Mr. Van Choate's, could not be used for the needle instruments, as they require a succession of currents in opposite directions. In this arrangement it could only flow in one direction, therefore printing instruments must be employed. F. W. WALE.

THE LATHE.—STARTING A TRUE THREAD

Sir,—Will one of your clever optical correspondents tell me what number of lenses (and at what distance from one another they are placed) there is in a good 3½in. magic lantern?

In article 5 on the lathe, you mention a mode of starting a true thread, and say:—"Put a shell on the mandril," &c. That would be a source of trouble; instead of which I put a small toothed wheel to gear into another, thus:—



No. 1 being the one on the mandril, No 2 the one carrying the hub. No. 2 being supported by a plate that is carried by the back support of the head, this gives a motion from the mandril nose and toward the poppet very handy when chasing left-handed threads; for right-handed threads a small pinion is introduced between the wheels, the plate having a slotted hole to allow the wheels to approach or recede from one another. This arrangement saves disturbing the mandril; of course we do not use such apparatus but for learners or people out of the run of practice; it will cut up a very true thread. S. NISBET.

CASE HARDENING IRON.

Sir,—In No. 6 of the ENGLISH MECHANIC, page 63, I find an article on the hardening of iron, in which it makes mention of the use of powdered potash, and then allowing the iron to gradually cool down. It being in my line of business, I resolved to try the experiment, as it was a new idea to me. I found that all qualities of iron were harder, and some would resist the best of files when heated to a red heat, covered with potash, and then cooled in cold water; whilst in the other way of allowing to cool gradually down it would not resist the file.

WM. HAMMERSMITH.

REMOVING STAINS OF DRY PAINT.

Sir,—In the ENGLISH MECHANIC of the 23rd of February, I notice a short article headed Chloroform for Removing Stains of Dry Paint. I cannot help expressing surprise that the great solvent power of chloroform should be quite unknown to many chemists. I have used chloroform mixed with a small quantity of spirit ammonia composed of strong ammonia, for nearly five years, and I may say it has been wonderfully successful in every instance, both for removing stains of dry paint, from the most delicate silks and many other fabrics. About two years ago, I took a small inlaid table out of a painter's shop, and although the table in some parts was almost the eighth of an inch thick with dry paint, by a careful application of chloroform I succeeded in restoring it to its original beauty. Trusting I have not trespassed upon your valuable time, I hope this may prove of service to your readers. M. BURDON.

THIN SHEETS OF IRON.

Sir,—In your journal, page 231, 26th ult. you give an account of some wonderful instances of tenuity in iron plate rolling; 4,800 sheets being required to make up the thickness of one inch:—*i. e.* 300 to be equal to 1-16th of an inch.

I want to get some thin metal, either iron, steel, copper or zinc. Messrs. Hullam do not roll for sale; Messrs. Loyd's, Foster and Co. have nothing beyond 30 W. G., and Mr. Parry, of Ebww Vale, is, I should think, too vague an address. Parry is as common a Welsh, as Smith is an English name.

My object in now writing is to ask you to oblige me, and probably hundreds of others who have your journal from the first (March 31, 1865), with some information as to where, and from whom, these very thin sheets of metal may be procured.

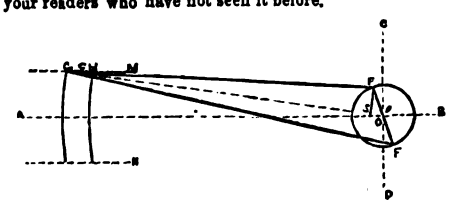
I observed in this week's impression an enquiry for strap cement. Good glue previously soaked a week in good vinegar or very old cider, and then mixed by heat with half the weight of common treacle, will, I think, be the thing required. J. ROBERT HULL.

[Perhaps some of our numerous readers may be able to furnish Mr. Hull with the address.—ED.]

ECCENTRICS.

Sir,—Having occasion to set some eccentrics on a locomotive crank axle, and seeing a method given by James Morrison in the monthly part of the ENGLISH MECHANIC, I tried it, but found that it would not do, as it would give the same amount of linear advance for a short eccentric rod as it would for a long one, supposing the centres of the link and the lap and lead to be the same.

I enclose you a sketch of a method which I have tried and found to answer, and which will be useful to some of your readers who have not seen it before.



Let A, B, be the horizontal or centre line of motion, and O, the centre of the driving axle; through O, draw the vertical C, D, and describe the circle E, F, equal to the travel of the valve; draw the lines M, N, parallel to the centre line and equally distant from it; M, N, being the distance of the centres of link; on the centre O, with the length of eccentric rod as radius, intersect the line M at S, and draw S, O; set off O S, equal to the lap and lead, and erect the perpendicular E, S; draw the diameter E, F, then O, E, and O, F, are the positions found for the lead of the back and forward strokes; then from E, and F, as centres, with the length of eccentric rod as radius, find on the line M, the points G, H; join E, G, and F, H; these are the positions of the eccentric rod for the forward and back strokes, and the interval G, H, represents twice the linear advance of the valve. C. CLIFFORD.

TOOTHED WHEELS.

I think the following rule for toothed wheels might be useful to some of your readers:—

Let D = Diameter of pitch line.
N = Number of teeth.
P = Pitch.

Then the

$$D = \frac{N \times p \times \cdot 32}{D}$$

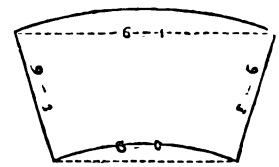
$$N = \frac{D}{p \times \cdot 32}$$

$$\frac{D}{N \times \cdot 32}$$

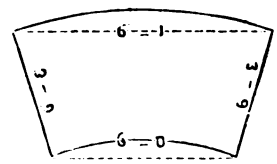
C. CLIFFORD.

TEMPLATES.

Sir,—The MECHANIC for February, 23rd, 1866, is to hand. There is a little mistake in the figuring of example for template making. You give



I gave



This will be seen to be an error, as there are no boiler plates rolled the size you give, in fact, not in South Staffordshire. I am sorry to trouble again, but if you will correct this, I will be extremely obliged. CETERETAS.

PITCH OF WHEELS.

Sir,—I regret that Jas. Sharpe before writing to you, impugning the correctness of my reply to Wm. Gale, did not take the trouble to understand it. In that reply I distinctly described the pitch of the teeth of a wheel to be so much of the pitch circle as is embraced by one tooth and one space. Jas. Sharpe has chosen to alter this arc of the pitch circle into the chord of the arc, and has so arrived at his erroneous conclusions. I have only to say that the information given in my reply is absolutely correct, as no doubt your correspondent will find upon further enquiry, if he takes he trouble to make it. C. A. T.

OUR SUBSCRIBERS' NOTES AND QUERIES.

ELECTRO-MAGNETIC ENGINE.—If Mr. Willis would kindly explain the various parts of his doubtless excellent drawing, he would very greatly oblige one who is not "up" to the subject.—VERITAS.

GALVANIC MAGNET.—I shall feel much obliged if any correspondent will give me a slight sketch and the details for a galvanic magnet, namely, how the wire ought to be placed, how fastened, and the strength of (Smee's) batteries to be used.—ELECTRO.

INDUCTION COIL.—I have gone to much trouble and some expense, in making an induction coil as described by "Electra," in No. 25 of the ENGLISH MECHANIC. I entered into every detail, but before putting a condenser, I thought it advisable to run a current through the coil, and greatly to my disappointment I felt no shock but a very smart pricking, accompanied with minute red sparks. I used a Bunsen's battery. Will "Electra" kindly explain the cause of this failure?—E. WATLEY.

MARINE GLUE, ELECTRO MAGNET, &c.—Can any reader answer the following questions for me:—1. Marine glue. How to use it, and ought the work to be warmed before applying the glue or not? 2. Electro-magnet. I have an electro-magnet made of a piece of iron, 1in. in diameter, and 13in. long bent into a horseshoe. This was first covered with silk and varnished, and then 1lb. of No. 18 covered copper wire was wound on with strips of silk between each layer of wire, and it was finally varnished. Now this when connected with a Smee's battery will lift only 6lbs. Can it be made more powerful without using any more wire? 3. Gilding. Is there any other way of darkening electro-gilt articles than that given by T. Allen, last week. I made the solution as directed by him, but it only took all the gold off without darkening it.—INKPOT.

GRINDING.—Will any reader inform me how to grind circular knives to lawn mowers.—GEORGE GROVES.

BORING.—Can any reader tell me how to bore deep holes in ornaments made of the grinders of the elephant? Owing to the alternate layers of hard enamel, soft ivory and brittle

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cement, of which they are composed, I cannot manage to drill them to any depth with the same tools I use for other ivory.—F. S. S.

Stay and Screw Stock.—Can any reader give a description of a handy universal back stay for a 8-inch slide lathe, to travel with saddle, to take in from ½ inch to 8 inches? Also of a simple screwing stock, one with both shanks in one piece preferred, without loose plate at top.—Rule Britannia.

Bevel Wheels.—Can any reader inform me how much thicker the wood teeth of a bevel wheel ought to be than the iron tooth wheel, that runs into it, and the rule to find the thickness of the teeth? Which ought to be driving-wheel, the wood or the iron tooth?—George Lucas.

Welding Cast Steel.—I have used the following receipt for welding cast steel. Pounded borax 1lb., sal ammoniac 1oz.; melt in a crucible, then pound and mix with 1lb. of quick-lime. We have some large hooks to make, that when put into a cistern of syrups of salts were eaten away in about two or three weeks. I should like to know how to coat them to make them stand longer.—Q. O. N. (Blacksmith).

Tube Plates and Tubes of Marine Boilers.—Can any reader inform me if there is any remedy known to prevent the destruction to the tube plates and tubes in marine boilers caused by the acid from the tubes of the surface condenser? Some have adopted the plan of tinning the condenser tubes, but I am not aware whether it answers the purpose or not. I have some boilers under my charge that are affected by it, and I wish to know how to prevent it going any farther.—H. U. Proman.

Safety Valve.—Will any reader favour me with a detailed elucidation of the following theory relating to the spring or weighted safety valve, as set forth in the English Mechanic of the 23rd ult.? Thus—"That by the instantaneous reduction of steam pressure under the valve, so soon as an outward current has been established, motion takes the place of dead pressure, consequently the pressure in the boiler sometimes rises dangerously above that to which the safety valve is loaded." The above has been advanced to account for the small rise of the valve from its seat. Also the rule for finding how much area is exposed to the escaping steam through the lever being raised a certain distance by over-pressure? The valve seat assumed 45°, area of valve, length of lever, and fulcrum being given.—Joseph W. Clarke.

Wheels for Screw-cutting.—Will A. Cranston kindly put his rule in a more simple form for getting the wheels for screw-cutting?—F. Townsend.

Rotary Engines.—What are the practical difficulties to be overcome in constructing a rotary engine? 2. The main or general cause of failure in rotary engines? 3. Is a rotary engine desirable? 4. Is power lost in converting a rectilineal into a circular motion? 5. Are there uses to which a rotary engine is better adapted than other engines? Will some kind reader give me information?—I. Z. R. I.

Engine-Turning Machine.—A correspondent (No. 42) gives an interesting description of the manner in which engine-turning machines are worked. Will he inform me where I can obtain one for engine-turning watch cases?—A. M.

Fly-wheel.—Will Mr. G. Kirkwood be kind enough to favour your readers with a description of the hand fly-wheel which he mentions in Vol. 2, No. 27, page 8, of the English Mechanic?—Hand Fly-wheel.

Steam Cylinder.—Can any kind correspondent tell me how to set about solving the following question:—The diameter of the cylinder of a locomotive is 16 inches, the length of stroke 21 inches, the driving wheel is 6 feet diameter. What would be the force applied at the circumference of the wheel when worked up to a pressure of 100 lbs. per square inch?—Q. E.D.

Punching Machine.—Can any reader inform me where to obtain a machine for punching card board rounds for pill boxes.—G. H.

Metallic Tellurium.—Will any reader inform me what is about the price of metallic tellurium?—R. Ross.

Fruit Stone Smashing.—Will any reader inform me whether there is a machine for smashing the stones of cherries. I have hitherto done them by hand with a wooden beater.—D. S. S.

Bronzing.—I thank J. D. for his information as how to clean brass (No. 46). I shall be much indebted to him if he will give me some instructions about copper and olive bronzing, also how to relieve those parts of pressed work which are round as in cornices and husks, the kind of bronzing I mean is that used for gas-fittings.—H. A. Yeldar.

Cement.—Will any reader tell me the best cement to use for cast iron pipes, spigots, and fascets, and for the joints of hot water pipes?—William Young.

Amalgam of Copper and Aluminium.—Will any reader furnish me with a receipt for making these?—Harod.

Grinding Pebbles.—Will any reader tell me how to cut, grind, and polish pebbles for brooches? I have a quantity which I consider of some value.—Uranus.

Polishing Turner's Work.—Will any reader inform me how to polish small hardwood turner's work, giving the material used for the purpose?—Rookwood.

OUR SUBSCRIBERS' EXCHANGE.

Grinding and Polishing.—In No. 47, Astro wishes for information as casting, grinding and polishing specular for telescopes, &c. If he will send me his address I will send him my experience.—Edward Pickles, 28, Winding-road, Halifax, Yorkshire.

Minerals.—I have a number of minerals and fossils which I should be glad to exchange for a working model of a steam engine—Address F. S. 287, Holloway-road, N.

Photographic Apparatus.—I have an excellent Photographic Apparatus, consisting of Stand, Chemicals, Plates &c., which I would exchange for a good compound microscope or a useful Lathe and Tools.—Address C. M. 41, John-street, Edgware-road.

If Ceteratas will write to Robert Jenkins, Masbro' Boiler Works, Rotherham, he can obtain the information he is asking for in your number 48, Vol. II, date 25th February, 1866.—Rotherham.

Telescope Object Glass.—I have a good Telescope, Object Glass, 2 inches diameter, 36 inch focus, magnifying power about 75 times, which I should be glad to exchange for a small Lathe.—Address F. D., 18, Windsor-road, Jersey.

Address Wanted.—"Astro" will oblige by forwarding his address to the Editor of the English Mechanic; a letter is waiting for him at the office.

REPLIES TO QUERIES.

Aberration.—Errata.—May I ask Bickerdike to insert, with a pen and ink, the following letters in the diagram printed at p. 337:—A capital E at the bottom of the left-hand tube and a small s at the top of it; and to make a dash (′) over the E and S belonging to the right-hand one? The omission of these, on the part of your wood engraver, makes the accompanying remarks and references unintelligible. Your compositor too, in line 30 has put "tubes" for tube, and in line 64 "munature" for miniature.—A Fellow of the Royal Astronomical Society.

Lightning.—The zigzag form assumed by lightning is owing to the resistance offered by the air to the disruptive discharge. Should Mr. Henry H. Clayton possess, or have access to, an electrical machine and apparatus, he may satisfy himself of this by fixing a small ball on to the prime conductor of the machine, and taking sparks from it, by means of a large one (which he should remove to the limit of the striking distance). He will find the intervening sparks present precisely the forked appearance which is seen in lightning. If now he will exhaust the air from a tube having a metallic knob at each end of it and take sparks through the intervening vacuum, he will find (the resistance of the air being now removed) the whole tube filled with a vapourous kind of light strongly resembling that of the Aurora Borealis.—Z.

Form of Lightning Flashes.—In answer to H. H. Clayton on the subject of lightning taking a zigzag direction, I beg to inform him it is generally supposed to be caused by "the lightning condensing in the air in the immediate advance of its path, and flying from side to side in order to pass where there is the least resistance." When the flash is straight is when the distance through which it passes from one cloud to another, or to the earth, is small, so that the air in advance of its path is not sufficiently condensed to fly from side to side. Sheet lightning is caused by the light of a flash being reflected from clouds when the flash itself is concealed from view. Lightning sometimes assumes a globular form. The reason for this is not exactly known, but is supposed to be caused by the almost equal pressure of the atmospheric air around the flash.—Electrician.

Acoustics.—"Lardner's Handbook of Natural Philosophy" contains a very good treatise on acoustics, well suited to your amateur correspondent J. H. It forms part of the volume on "Electricity and Magnetism," and cannot be obtained separately. The price is 5s. Walton and Maberly, of London, publish it.—Hear, Hear.

Acoustics.—I think "Ganot's Physics," translated by Atkinson, will suit J. H. I do not know of any work that has especial reference to the vibration of strings; but I do not think there is a better work than Ganot's Physics for acoustics generally.—B. P. Ellis.

Alarum Clock.—If "Vertumnus," No. 48, can fix a larger bell into his American, and bend the hammer that it may strike both the inside edges of the bell alternately, he will have a very effective alarum. If this will not answer he can have an alarum movement made to order, with crown wheel escapement (like a bottle-jack) to work the hammer. English alarums are entirely gone out.—Horologer.

Rain-Gauge.—Any vessel will do for a rain-gauge, provided only that it be cylindrical, and that the area of the mouth or receiving aperture be determined with extreme accuracy. This can only be done by turning it in the lathe to some definite diameter. Ordinarily the top of a rain-gauge is formed of copper funnels, communicating by a pipe with the receiving vessel. To measure the rain caught, we must employ a truly cylindrical glass jar which must be thus divided:—Let a represent the diameter of the receiving vessel, b that of the glass jar, c the depth of rain in the receiver (considered cylindrical), and x the required depth of the glass jar to measure such amount; then, since area × depth gives volume

$$a^2c = b^2x \text{ or } x = \frac{a^2c}{b^2}$$

Thus, suppose the diameter of the mouth of the gauge to be 12in., and that of the glass jar 2in.; to find what depth of this jar will measure ¾in. we have

$$\frac{12^2 \times \cdot 25}{2^2} = x; \text{ or } x = 9$$

Therefore, 9in. of a jar 2in. in diameter will measure ¾in. of rain received by a surface 12in. diameter: divide this 9in. into 25 equal parts, and each will measure the one-hundredth of an inch caught in the larger vessel. Having said which, however, let me advise "Astro" to give up all idea of making a gauge himself, and go either to Casella's, or to Negretti and Zambra's for one of their cheap ones. The price is only, I think, 10s. 6d., and it will cost "Astro" actually more in hard cash to construct one at all approaching them in accuracy.—Long to Rain over us.

Telescope Stand.—Let me refer "Astro" to No. 14 of the "Astronomical Register," for February, 1864, (published by J. D. Potter, 31, Poultry, London, price 1s.) for an excellent description, by a Mr. Vallance, of a cheap equatorial stand, made mainly of gas-piping. The fullest explanation is given of its construction, with engravings of all the details; and there is added a description of a very clever, but absurdly simple, contrivance for driving this in opposition to the diurnal motion of the earth. The whole affair costs but a few shillings, and when fitted with old theodolite circles, as was done by Mr. Vallance, suffices to find bright stars in the day time. Moreover, it is competent to carry a much larger telescope than that which your correspondent possesses. I know nothing whatever of Mr. Vallance, and have not, of course, his permission to transfer his article to the columns of the English Mechanic; but, could such permission be obtained, it would be the means of bringing an exceedingly cheap and effective mode of mounting a telescope before numbers to whom such information might be of great value.—A Fellow of the Royal Astronomical Society.

Spectra for Telescope.—In reply to "Astro" the following can be depended upon. Copper, two parts, as pure as it can possibly be procured. Pure grain tin, one part. Melt each in a separate crucible; when both are melted, mix and stir with a wooden specula, keeping up a good flux to prevent oxidation, and pour quickly into the mould, the intended face always being downwards—grind and polish same as lenses.—Veritas.

Photographic.—I am not aware that there are any special colours sold for colouring photographs, but there is a kind of size sold, which is first applied, and when dry the colour will lay on.—B. P. Ellis.

Alarum Clock.—I think Vertumnus will find that the American clocks sold at 12s. 6d. make quite enough noise to wake him up. I know of one now that has been going two years. It goes very well.—B. P. Ellis.

Knitting Machines.—J. W. Preston enquires who makes knitting machines. If he means machines for knitting stockings, I saw one working at the Dublin International Exhibition. They are manufactured by S. and J. Ward, Mansfield, Nottingham.—W. S. C. Paton.

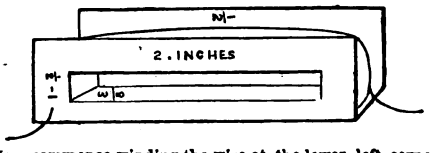
George Bower.—I use a cast steel for all my lathe and other spindles, and harden in lime water.—Henry Riley, Tool Maker, Sheffield.

Feathering Propeller.—I think that if Mr. A. F. Thomson were to examine Mr. Woodcroft's and the Prince Alfred feathering propellors at the Museum of Patents, South Kensington, he would be convinced that they are more simple than his own, in which the revolving would cause friction.—H. H.

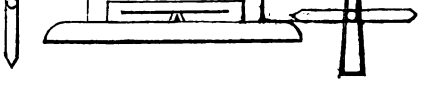
Model Steam Boat.—I can give R. T. the dimensions of a vertical high pressure engine, bolted on to a vertical tubular boiler which is best and cheapest, if he will give me breadth and depth of the boat. Two cylinders are unnecessary. I do not think it possible to propel so small a boat at eight miles an hour. I do not understand the meaning of the price of borings and turnings.—H. H.

Colour of Jewellery.—In reply An Amateur, No. 43, the colour upon 15 carat gold jewellery is obtained by boiling in an acid that dissolves the copper, leaving a thin coat of pure gold upon the surface. To obtain the same colour, gilt jewellery must be made of an alloy as near the colour of 15 carat gold as possible—only a thin coat should be put on first, then scratchbrush it, then put on another or two until the required colour is obtained. Pure gold only should be used and it should be attached to the copper battery wire by a piece of platinum wire, to keep the solution quite free from copper.—Horologer.

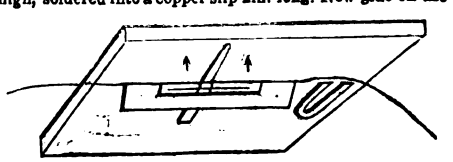
Electric Telegraph.—In answer to B. P. Ellis I send the following method of making a simple electric telegraph. The base consists of a piece of mahogany eight inches square and one inch thick, with a hollow groove cut in its centre two inches long and a half-inch wide. The coil consists of 50ft. of covered copper wire, No. 30 gauge, wound on a frame of card 1⅝in. long, ⅞in. broad, ⅜in. deep in the open part; an edge or flange of card 1⅝in. wide, 2in. long, is stuck to each side to keep the wire in its place.



Now commence winding the wire at the lower left corner and wind from right to left. Each end of the wire must be stripped of the cotton, so as to have the wire clean for the electricity to pass. The coil is mounted in the stand by inserting the two lower edges in the groove so that the floor of the coil is level with the stand. The needle is 1in. long,



1-12th of an inch wide, of hardened and thin steel, and fitted with a brass cap turned to a true cone, to receive the steel point on which it is to be balanced. The needle is then to be magnetised by drawing it across the face of a common horseshoe magnet three or four times. This needle is now balanced on a steel point 3-16ths of an inch high, soldered into a copper slip 2in. long. Now glue on the



needle (a piece of glazed letter-paper tapering from ⅛in. to a point and 2in. long) at right angles to the magnetised

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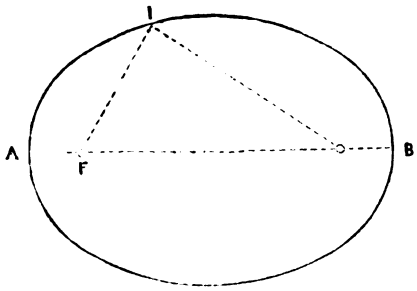
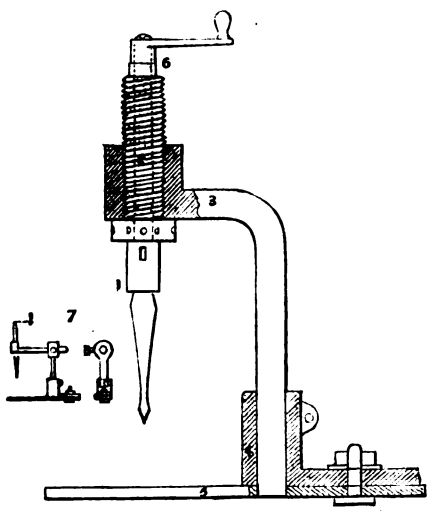
needle. To limit the vibrations of the paper index, drive two copper pins in the base ¼in. away each side of the index. Place outside the coil a small magnet at right angles to the coil to keep the paper index in the middle of the two pins, it will then appear as shown in the last diagram.—G. CUZNER.

ELLIPSIS.—Having seen the question of "Compass," I beg to give him the following most correct method by which to describe an ellipsis. Take a thread or piece of string the length of the transverse A B, and fasten its ends to two pins and stick them in at the foci F, F, then stretch the thread, and it will reach to I, in the curve,



and by moving a pencil round within the thread, keeping it always stretched, it will trace out the ellipsis.—TRAPEZIUM.

A TURNER OR MANDRIL BOUND.—This gentleman is right in the supposition that taper mandrils are, or have been, made and work well. A factory in which I worked a good number of years had and have a great number that run well and without repairing, the majority twenty or thirty years, doing both heavy and light work (the use of a shoulder enables you to have a larger nose to your mandril) and if "Mandril Bound" will bore and turn a few holes and plugs in some pieces of hard wood, he will soon find the taper that will not bind at the pressure necessary to keep the mandril tight. Let them be different tapers, keeping the largest size of the hole, all of one size. I have not seen in the descriptions for the hardening steel, say, taps, drills, &c., the use of oil in tempering advocated. Get your steel made hot in a piece of iron tube of a convenient size, a more regular heat is obtained, drop out of tube and harden, clean off with emery stick, and bring down ever clear coke fire, holding the tap in a pair of light tongs; take an oiled brush and pass along the cleaned part, that is, to show the colour, taking care not to let the oil cake, and show false by repeating again and again the passing of the oil brush, well charged, over the part desired; when the colour is obtained dip as usual. S. NESBITT.



A USEFUL HAND DRILL.—1, drill spindle; 2, hollow set screw; 3, nut and standard; 4, hand-rest of lathe; 5, a ¾in. by 3in. plate of wrought iron of a length in proportion to the size of the other part; 6, washer; 7, another way, for drilling holes at any angle.—S. NESBITT, Fitter and Turner.

AN UNSUCCESSFUL CHEMIST will find the following mixture will burn under water and the mixing is not dangerous. Powder, 3 parts; Sulphur, 3 parts; Saltpetre, 1 part; to be finely powdered, mixed, and put into paper cases. If one of these cases be weighted with lead in order to make it sink, lighted and thrown into a pond, it will burn under water until all the composition is consumed. —GEO. HARDEY.

LUTES.—I think J. H. M. will find the following answer his purpose, I have not tried them myself, so cannot speak from experience. No. 1. Plaster of Paris made into a soft paste with water and applied immediately—this will bear a heat approaching redness. No. 2. Slaked lime and linseed oil beaten into a paste. No. 3. Stourbridge clay and a little sand mixed with water into a stiff paste, a small quantity of asbestos or chopped tow is generally added to bind it together. The crucible that is to serve as the lid should be rather smaller than the bottom one, so as to leave space for a band of the cement between the two; this space should be pressed full of the lute, leaving a pinhole to serve as a safety valve. Allow plenty of time for drying before placing in the fire.—GEO. HARDEY.

CHEAP POLISH.—In a recent number, J. H., in his reply to some some enquirer *re* Stain and polish, gives the following recipe for a cheap polish. 1 pound of shellac, dissolved in 1 quart of wood naphtha; cost, shellac 8d., naphtha 2s. 4d. If it is a French polish that is wanted, J. H. is woefully wide of the mark. 1 pound of shellac in a quart of naphtha would make a good cement, but he would find it a tough job to polish with it; and if he will undertake to supply shellac at 8d. per lb., I can assure him of a very extensive trade. Good shellac will cost not less than 1s. 8d. or 2s. per pound. Naphtha is worth about 1s. 4d. the quart, not 2s. 4d. The following is a good polish: shellac 6oz., naphtha 1qt., benzoin ½oz., sandrac 1oz. J. H's. stain would also I think be looked upon by a polisher with not a little suspicion, and the "knowing ones" would I doubt not elect to stick to their dragon's blood and naphtha.—W. PICKARD.

VENTILATION.—The damp clamminess on metallic surfaces complained of by Amos Fletcher is the result of the condensation of vapour, and is not purely a question of temperature, though partially so, but principally a question of ample ventilation: and I opine neither tinning, japanning, polishing, or deadening the surface, would avail much; whilst free and full ventilation was provided.—W. PICKARD.

VELOCIPEDE CONSTRUCTION.—According to request I send rough sketches of my velocipede. Fig. 1, is a side elevation, and fig. 2 a front elevation, and fig. 3 a back elevation of a single vehicle. The large wheels run loosely on the axle, being driven by a large toothed wheel on the crank shaft, gearing into a smaller one on the axle of the running wheels. The small running wheel behind is acted upon for steering by an apparatus represented at fig. 3. The frame is about 4ft. long and 1ft. wide, on the top of which is fixed the seat. The large wheels must not be less than 3ft. in diameter, and the small back one 1ft. 6in. The largest of the two toothed wheels is 2ft., and the smallest 1ft., so that one turn of the crank shaft gives two turns of the running wheels. The frame is fixed 6in. off the centre of the wheels by the bearings of the axle and crank shaft. The treadles are bolted to the back to two pieces of iron B, coming from the frame; the cranks are each 3in., and are worked by treadle hooks from the treadles; the small toothed wheels slip on the axle, and are kept against the naves of the running wheels by spiral springs around the axle. There is a connecting rod on a sort of hinge fixed to the side of the seat with a handle at the top end, and a fork at the other, which fork goes round a groove fixed to the back of the small toothed wheels. At the other side of the wheels are fixed three long pins which slide in and out of the nave of the large running wheels, and it

FIG. 1.

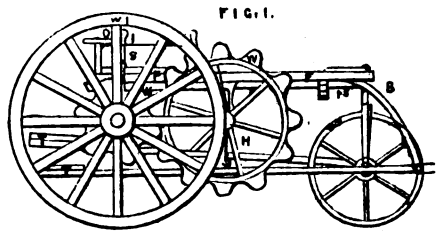


FIG. 2 FIG. 3 FIG. 5.

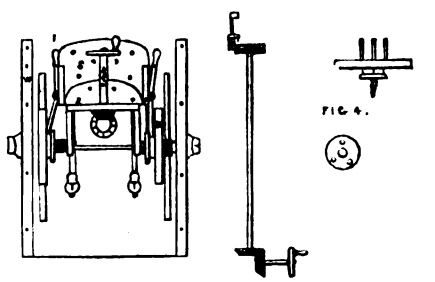
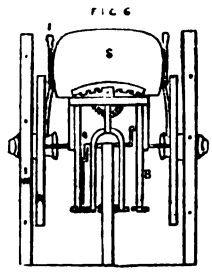


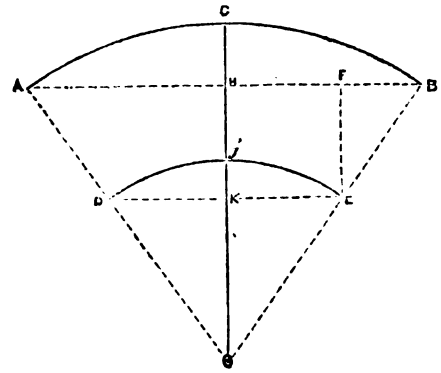
FIG. 4.

is evident that a person pushing the handles from him will cause the spring to collapse and the small toothed wheels to come towards the seat and so be out of gear with the large ones. One of the toothed wheels is shown at fig. 5 with the pins on one side and the groove where the connecting rod fits around, and the spiral spring which goes round the axle on the other. A section of the nave of the wheel where the pins slide in and out is shown at fig. 4; the same letters do for all the drawings. W 1, W 1, W 1, are the running wheels; W W, the toothed wheels; S, the seat; F, the frame; 2 1, the steering apparatus; T T, the treadles; H H, the treadle hooks; C C, the cranks; I I, the handles for throwing the large wheels out of gear. It may be constructed entirely of wood, except certain parts where iron is absolutely necessary. There is more work in making this velocipede than in many others, but I claim for this one, that it ascends hills and runs with half the power of any that I have seen, and also that when necessary to pull up quick the traveller has only to push out both handles and it is done at once.—EXCHANGE.

FIG. 6



TEMPLATES.—For the benefit of "Ceteratas" I send the enclosed method of finding the versed sines and radius when the chords and slant height are given.



Let C = chord of greater arc A B
c = chord of lesser a c D E
And h = slant height B E
S = versed sine G H
s = versed sine J K
Also let R = radius E O
And r = radius E O

Now $\frac{C-c}{2}$ = B F. Then by similar triangles we have

$$\frac{C-c}{2} : \frac{C}{2} :: h : R$$

$$\therefore R = \frac{hC}{C-c} = \text{the radius B O}$$

$$\text{Again } HO^2 = BO^2 - BH^2 = \left(\frac{hC}{C-c}\right)^2 - \left(\frac{C}{2}\right)$$

$$\text{or } HO = \sqrt{\left(\frac{hC}{C-c}\right)^2 - \left(\frac{C}{2}\right)^2}$$

$$\text{Hence } GH = \frac{hC}{C-c} - \sqrt{\left(\frac{hC}{C-c}\right)^2 - \left(\frac{C}{2}\right)^2}$$

$$\text{Or } S = C\left\{\frac{h}{C-c} - \sqrt{\left(\frac{h^2}{(C-c)^2} - \frac{1}{4}\right)}\right\} = \text{the versed sine G H.}$$

Again r = R − h.

$$\text{or } r = \frac{hC}{C-c} - h = h\left(\frac{C}{C-c} - 1\right).$$

Then $KO^2 = EO^2 - EK^2$ or by substituting we have

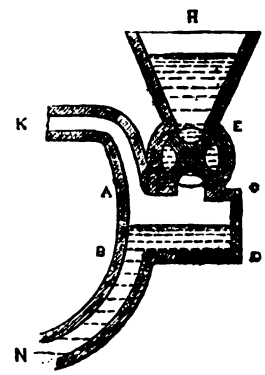
$$KO = \sqrt{\left\{h^2\left(\frac{C}{C-c} - 1\right)^2 - \frac{C^2}{4}\right\}}$$

$$\text{Hence } s = h\left(\frac{C}{C-c} - 1\right) - \sqrt{\left\{h^2\left(\frac{C}{C-c} - 1\right)^2 - \frac{C^2}{4}\right\}}$$

= the versed sine J K.

If Ceteratas will correspond with me, I will help him to the utmost of my ability.—DAVID KNIGHT.

BOILER FEED, WITHOUT PUMP.—Some few weeks since a correspondent asked the question how to feed a steam boiler without pumps, and I say at once that a pump is a nonsensical superfluity, except in cases where water is required to be elevated. In reference to this object I shall just specify one plan and satisfy the objec



tions that may be raised against it. Let A B C D be a box situated over the boiler or at any distance from it, but considerably higher than the level of the water required in the boiler. H is a cistern containing water, and E is a cock which has no passage directly through it, but has cavities in the sides of the plug, as represented. K is a pipe com-

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municating with the steam space of the boiler, and N the feed-water pipe. As the plug of the cock revolves they fill with water when under the cistern, and being carried round in the cavities, empties into the box A B C D, from whence it will run down the feed pipe into the boiler, no matter what is the pressure of the steam, because the pipe K brings steam to act upon both sides of the water, nor can any pressure prevent it from falling from the plug into the box. Some may object to this plan by conceiving a loss from the condensation of steam by the cold water in the box. But it is in reality no loss at all. If any quantity of steam is condensed by the water the heat is contained in the water which condensed it, and returned in that way to the boiler. Indeed, any one may discover that cold water cannot become hot without extracting heat, no matter by what process it is thrown into the boiler. Some engineers have comical notions in this respect, such as making the feed pipe always to go in at the bottom of the boiler, but it is an erroneous idea, for if they ejected the same quantity of water in a shower of drops amongst the steam it would not extract any more heat than when thrown in at the bottom of the boiler by a pipe as specified. But in reality the plan described has much advantage over the pump. In the first place the water thrown in by a pump condenses as much steam or extracts as much heat as in this way. In fine, there is no loss, as the water must be heated, so that they are equal on that account. But in the second place it requires just such another volume of steam to be expanded in case of the pump, in order to generate force to work the pump against the pressure of the steam, which is not the case with the plan I have specified, for there is no direct pressure against the passage of the water by this means, and it passes a volume of steam equal in bulk only to the water, which is not a quarter as much waste as the force required for a pump. It may not be always convenient to give a rotary motion to the plug as described, but the same principle may be done with the oscillation of a slide valve.—Ulrich Zuinglius, Birmingham.

[We have struck out the first portion of our correspondent's letter—as not of general interest. We would advise him to try an advertisement to capitalists—first of all securing provisional protection. Perhaps, however, he had better hold on a little, just to see what alterations will be made in the Patent Laws.—Ed.]

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

All letters intended for the Editor should be addressed to 75, Fleet-street.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

G. Franks.—The best qualitative test for bromides in solution is the solution of chloride of gold, which gives a splendid red colour.

L. Petersen (Archangel).—Many thanks; we have several readers in your city. In answer to your query, all the organic compounds in plants can, by their wonderful structure, be derived from the atmosphere and the rains of heaven.

W. P. Wheelwright.—Next week.

H. Y., Cotton Gin.—You must write more clearly; we really cannot arrive at your meaning.

R. Mercer.—As soon as opportunity offers.

Jessy Lathe.—In our next.

W. E. H. Lathe.—Can only be inserted as an advertisement, charged at the usual scale.

W. A. Mitchell.—We shall be very glad to receive an occasional contribution from your pen.

Junior Vulcan.—Sunday, the Queen's Birthday, and Good Friday.

A. Cranston.—Too late for this number. Perhaps in our next.

John Channing.—Your best course is to advertise. There are plenty for sale, and a single advertisement is certain to bring a number of answers.

Uranus.—We have given the recipe more than once. See also the articles on soldering.

William S. Andrews.—Received with thanks, but too late.

W. Baker.—Ozone is regarded by some as oxygen in an allotropic state, or as a peroxide of hydrogen. It is formed in every instance when phosphorus is allowed to act on moist air at ordinary temperatures.

James Cooper.—Answered in former numbers.

L. J. H.—See reply to An Amateur in present number.

Inquirer.—See back numbers.

W. H. S.—Yes; we have every reason to think so.

John Ashton.—Thanks for your kindness, but many answers have come to hand.

S. S. (Carnarvon).—We do not think that your design will answer the purpose of E. Parr.

P. K. (Dundee).—We think there was one published. Address a letter to the secretary of the Exhibition, Dublin. Enclose a stamp for answer.

X. Y. Z.—We thank you for the hint; we have before had reason to regret the errors of the draughtsman.

An Enquiring Reader will be answered in our next.

F. Winn (Brighton).—The symbol of Tungsten, or Wolfram, is W.; its equivalent 94·64.

John Jardine.—Your ideas are explained clearly enough. Perhaps in our next.

Matthew Downes.—For hair springs, try Ganeral and Callard, 27, Alfred-street, City.

J. F. T.—There is no reliable work published. The manufacture has become a large branch of industry, and you can procure them much cheaper through a respectable manufacturer, than you can hope to make them, after months of waste and disappointment.

Charles Fullard.—You had better advertise. Prices vary according to locality.

William Young.—The specifications are elaborate descriptions of newly patented inventions. The prices you will see in the list published weekly in these pages. We cannot forward them to you by post. Write to Mr. B. Woodcroft, office of the Commissioners of Patents, Southampton-buildings, Chancery-lane.

S. Hymers.—The mode in which heat operates, in bringing about chemical phenomena, is not very clear, but depends upon the intimate and occult qualities of substances.

Garth.—Longman and Co., booksellers, Paternoster-row.

J. Roberts.—You must explain yourself more clearly.

Magnet.—Too expensive for an amateur.

Jove.—Some think it preferable.

Iconoclast.—We will endeavour to supply the articles.

J. K.—See back numbers.

* We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher,". &c.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

518. Ernest Marie Du Boys, Paris, improvements in apparatus for measuring and registering the flow of water or other liquids.
520. Thomas Kennedy, Kilmarnock, improvements in water meters.
521. Alfred Moore, Chester, certain improvements in the method of and means for communicating with and transmitting power from place to place.
523. Thomas Williamson and Edwin Patrick Marren, Staley Bridge, improvements in valves.
525. James Barry, Cork, an improved dye.
527. Augustus Bryant Childs, 481, New Oxford-street, an improved automatic apparatus for roasting coffee and other substances.
530. Henry Spink Swift, Peckham, improvements in machinery or apparatus for propelling ships or vessels by hydraulic pressure.
531. Arthur Henry Robinson, 85, Haddington-road, Dublin, improvements in crabs or winches.
535. William Robert Lake, 8, Southampton-buildings, Chancery-lane, improvements in drills and in chucks for holding and operating the same and similar articles.—A communication.
544. William Donald Napier, M.R.C.S., Middlesex, improvements in fountains.
549. Henry Bright, 2, Union Parade, Leamington, improvements in electric clocks.
553. John Fordred, Blackheath, improvements in the treatment of certain products obtained in the refining of petroleum and of other hydrocarbon oils.
556. William Nunn, 179, St. George-street, Middlesex, improvements in ships' binnacle lamps.
557. James Parker, 6, Lilford-road, Camberwell, improvements in engines and apparatus for obtaining motive power and for using the foul air in mines as fuel.
562. James Dodge, Manchester, improvements in apparatus for tempering saws and other articles capable of being tempered between two heated surfaces.
569. John Scott Russell, Westminster Chambers, Victoria-street, improvements in building ships of war.
580. William Welch, King-street, Southsea, manufacturing and applying argillaceous, calcareous, silicous, and metal composition cements.
581. Peter Henry Lealand, Euston-road, Middlesex, improvements in binocular microscopes.

LIST OF SPECIFICATIONS, &c.

Published during the week ending February 24, 1866.

771. Steam generator, J. T. Romminger—10d.
772. Breech-loading fire-arms, J. T. Cook—1s. 2d.
773. Scarf, M. Eley—4d.
774. Yarn, I. Philippsthal—4d.
775. Socket for fencing and telegraph posts, A. G. Browning—10d.
776. Sewing machinery, A. V. Newton—2s.
777. Manufacture of puddled iron bars, &c., R. T. Crawshay and I. A. Lewis—4d.
778. Locks for safes, &c., S. Chatwood—10d.
779. Working puddled balls or blooms, W. Menelaus—10d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of The English Mechanic.

PROPERTY RECORD.

SALES AT GARRAWAY'S.

By Mr. Robt. Reid.

Leasehold residence, being No. 5, Gloucester gardens, Westbourne-terrace, let at £160 per annum, term 73 years unexpired, at £18 per annum—sold for £2,310.

Leasehold profit rental of £120 15s. per annum (for 8½ years), secured upon a house and shop, being No. 111, Tottenham-court-road—£560.

Leasehold improved ground-rent of £30 per annum (for 94 years), secured on three houses situate in Regent's Park-road—£600.

Leasehold residence, being No. 60, Clarendon-road, Notting-hill, let at £65 per annum, term 74 years unexpired, at £12 10s. per annum—£810.

Leasehold residence, being No. 64, Clarendon-road, aforesaid, let at £65 per annum, term and ground-rent similar to above—£700.

Leasehold premises, being No. 15, Adam-street, East, Manchester-square, comprising a house and premises known as the Wesleyan Reform Chapel, producing £101 per annum, term six years unexpired, at a peppercorn rent—£330.

Leasehold house, being No. 205, Seymour-street, Euston-square, estimated annual value £42; also an improved ground-rent of £7 per annum, secured on the house adjoining, No. 203, term 24 years unexpired, at £9 8s. per annum—£325.

By Messrs. Lomax and Flexman.

Leasehold residence, being No. 13, Dorset-street, Baker-street, Portman square, of the estimated annual value of £150; also some stabling, let at £26 per annum, term 22 years unexpired, at £16 16s. per annum—£740.

Leasehold stabling and coachhouses, being Nos. 1 to 9, St. John's-mews, Ledbury-road, Kensington, producing £127 per annum, term 99 years from 1851, at £70 per annum—£1,590.

Two leasehold residences, being Nos. 24 and 25, Senior-street, Harrow-road, producing £80 per annum, term 99 years from 1860, at £14 3s. per annum—£850.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Erection of an arcade for the Brighton Arcade Company. Particulars of Mr. John Ellis, 11, Austinfriars, London.

Completion of an agricultural implement factory, including chimney shaft, smith's shop, foundry, sheds, &c., for Messrs. E. Page and Co., "Victoria Works," Bedford. Particulars of Mr. Noher, 44, High-street, Bedford.

Works for deepening and widening a portion of the river Witham, and for raising and strengthening the banks thereof. Particulars at the Witham office, Boston.

Supply of Guernsey granite for three years to the St. Saviour's district Board of Works. Particulars at the offices, Emmerson-street, Bankside.

Erection of new buildings for the enlargement of the Middlesex House of Correction, Coldbath-fields. Particulars at the office of F. H. Pownall, architect, 30, Gower-street, Bedford-square.

Execution of the following works and materials for the parishes of Hackney and Stoke Newington for the period of one year:—Ballast—For the supply and delivery of ballast, shingle, and hoggin. Mason's Work—For the supply and laying down of York paving and granite curbing; also for repairs to the existing footways. Gas-Fittings—For the supply and fixture of lanterns, lamp-heads, stand-pipes and service-pipes, removing, altering, and fixing lamp-posts. Watering (for the season) four sections—45 horses. Particulars may be obtained at the office of Mr. James Lovegrove, C.E., surveyor to the Board, Town-hall, Hackney.

Erection of a new hall for the Bridgnorth Agricultural Hall Company. Particulars of R. Griffiths, Esq., architect, Stafford.

Erection of a temperance hall at Walsall. Particulars of Messrs. Loxton, Brothers, architects, Victoria Chambers, Wednesbury.

Redecorating and repairing of St. John's Church, in the parish of Wednesbury. Particulars of Messrs. Loxton, Brothers, Victoria Chambers, Wednesbury.

Erection of a new rectory house at Stoke Codlington, in the county of Buckingham. Particulars of E. F. Law and Sons, architects, Priory Cottage, Northampton.

Rebuilding the nave and chancel of the parish church of Oxenhall, Gloucestershire. Particulars of Mr. John Middleton, York-terrace, Cheltenham.

Restoration of Arnesby Church, Leicestershire. Particulars at the office of Millican and Smith, Horsefair, Leicester.

TENDERS SENT IN FOR BUILDING AND ENGINEERING WORKS.

For addition to house at Cold Ash, near Newberry. Mr. W. Harvey, architect:—Lamble (accepted), £750

For new front, re-seating, &c., Northgate-street Chapel, Bury St. Edmund's. Messrs. Bacon and Bell, architects:—Rednall (accepted), £450.

For new Hotel, Harwich. Mr. Horace Darken, architect:—Dobson, £1,001 10s.; Lea and Baker, £956 5s.; Butcher, £863; Everitt, £859 10s.; Newton, £857; Wilding, £794.

For a residence, West Bergholt. Mr. Horace Darken, architect:—Holland, £950; Shepherd and Son, £920; Dobson, £898; Eade, £890; Lee and Baker, £872; Everitt, £849 15s.

For new shop-front and fittings at 157, Brompton-road. Mr. Joseph S. Moye, architect:—Sapwell, £320; Stimpson, £280; Parkinson, £235 10s.

For villa residence, Barnet. Mr. Joseph S. Moye, architect:—Walton (accepted), £714.

For alterations at Nos. 61, 62, 63, and 64, Houndsditch, Mr. G. Sparks architect:—Heeps (accepted), £585.

For dwelling-house, Upton-lane, Stratford, E. Mr. J. M. Smith, architect. Quantities supplied by Messrs. Curtis & Son:—Rivett (accepted), £943.

For alterations and additions to a warehouse, Castle-street, City. Mr. Herbert Ford, architect:—Palmer & Son (accepted), £350.

For part of the decorations to the Elms, Erith, Kent. Mr. Herbert Ford, architect:—Horner (accepted), £78.

For alterations and additions to the Queen's Arms, Caledonian-road. Mr. T. Brookes, architect:—Cowland, £500; Perry, £549; Batchelder, £543; Gillet and Wisbey, £530.

For alterations to the Duke of York, Upper Rathbone-place. Mr. T. Brookes, architect:—Gillett and Wisbey, £385; Lawrence and Baugh, £369; Tracey, £332; Walker, £285.

For alterations to the Duke of York, Clerkenwell. Mr. T. Brookes, architect:—Keene, £298; Worme, £270; Martin, £273 15s.; allowed for old materials, £10; Gillett and Wisbey, £275; allowed for old materials, £15.

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SCIENTIFIC NOTES.

PROFESSOR TYNDALL ON HEAT.—At the Royal Institution, Professor Tyndall has been delivering a course of lectures on "Heat" to large audiences. He states that as heat is simply the vibration of the ultimate particles of all bodies, the less that vibration the greater the sensation of cold. Ice contains much heat, and will liquify and boil solid carbonic acid. There is no evidence that any substance on this earth has ever been deprived of all its heat, but the point at which that result is obtained is believed to be 273 degrees below the zero of the Centigrade scale. The Professor charged the lecture-room largely with moisture, and in the course of his experiments formed clouds, snow, ice, and hoar frost. By artificial means, he imitated the geysers of Iceland, a great flood of hot water and steam shooting up through a hole in the middle of a large iron basin. Finally, he reproduced, on a small scale, the Strokr, an irritable boiling spring, which exerts its powers whenever lumps of dirt or large stones are dropped into its mouth.

On the 4th of January Dr. L. Tietjen, of the Observatory of Berlin, whilst observing the 83th small ultra-zodiacal planet, which was discovered in America, in September last, by Mr. Dolman, made the discovery of another, the 86th, belonging to this remarkable series of planets, which have been found during the present century between Mars and Jupiter.

A crystallized mass of gold, weighing 201 ounces, has recently engaged the attention of mineralogists in New York, to which city it was sent from El Dorado county, California. The crystals, mostly imperfect, are strangely grouped, and have some peculiarities which are worth studying. The value, as estimated in New York, is 4,000 dollars.

TELEGRAPHIC NOTES.

TELEGRAPHIC REFORM.—A petition on this subject has been presented to Parliament by Mr. M'Laren, one of the members for Edinburgh. The petitioners "complain not only of the high rates charged by the existing companies for the transmission of messages, of frequent and vexatious delays in the delivery, and of their inaccurate rendering, but also that many important towns, and even whole districts, are unsupplied with the means of telegraphic communication." They suggest that "the existing companies might be amalgamated under the sanction of an Act of Parliament, which might fix the maximum rate or rates of dividend and a moderate maximum tariff. Another means of effecting improvement would be the passing of a general Act, authorising, under proper regulations for the public interest, the erection of telegraphic posts along any public way throughout the United Kingdom. A third mode would be by the Government assuming the management of telegraphic communication, and extending the lines; so that they might at least include all the more important towns and villages,—such, for example, as have Money-order Offices. The successful result of the reduction of the rates of postage, and the close analogy between the post-office and telegraphic system, justify the expectation that the adoption of a uniform tariff—say of 6d. for 20 words—would, within a few years, leave a surplus revenue, while it would be also a great boon to the community." The petitioners "earnestly desire that a royal commission should be appointed to inquire into the present system of telegraphic communication, with a view of its improvement."

RATING OF ELECTRIC TELEGRAPHS.—In the House of Commons on the 26th ult., Mr. H. Surtees asked the President of the Poor Law Board to state on what principles he considered Electric Telegraph Companies ought to be assessed for the purpose of the poor rate. Mr. Villiers said that this was a matter that had been settled for some years past by the courts of law, and upon the principle then laid down—namely, that everything above the surface and below the surface was to be considered as land, upon this principle the pipes used by water companies under the surface are rateable, and the wires which conduct the electric fluid, whether through the air or under water or in the soil, constitute an occupation of the land, and as such form a subject to be rated.

SUBMARINE TELEGRAPHS.—The Submarine Telegraph Company find that their present annual cost of repairing cables is £5,300. The proprietors have decided to appropriate £3,000, half-yearly for this purpose in future, while, in addition, ten per cent. of the gross receipts are set aside as a reserve fund, which now amounts to £17,948.

PHOTOGRAPHIC NOTES.

NEW INTENSIFIER OF CYANIDE OF IRON AND URANIUM.—Prepare solutions of sulphate of uranium and cyanide of potassium and iron; mix them together in equal proportions when required for use. Pour some of this liquid upon a fixed negative, which will produce a brown deposit on those parts covered with reduced silver. Leave the negative to dry. It becomes still blacker in drying, but after being varnished it resumes all its intensity. The liquid poured off from the negative may be employed again and again. This intensifying appears to be very important for the reproduction of drawings or engravings. No other method gives so much regularity and vigour, while leaving the negative transparent.

COLLODIO-CHLORIDE IN AMERICA.—Without doubt the most important improvement in our art during the past year is the collodio-chloride of Mr. Simson. It is such a simple and certain process that it was at once adopted by the profession; it has become a standard method, and will probably last as long as chloride of silver is used in printing. We do not remember that in the history of our art any other process has so soon received the endorsement of our most competent experts.—*American Journal of Photography.*

CAMERAS FOR DOUBLES.—Mr. G. Williams, of Holloway, sends us, *Photographic News*, some examples of double and quadruple portraits, with an intimation that he has contrived a simple and efficient modification of the camera for easily producing them, which may be applied to old cameras, arrangements having been made to effect this at the establishment of Mr. Hughes, Oxford street. The object in view is not so much to produce "doubles," as to afford facilities for producing groups in which the various figures are taken in succession, thus giving freedom of arrangement and facility for focussing each figure, and securing definition in all.

PHOTO-LITHOGRAPHIC REPRODUCTIONS.—It is stated that the Academy of Sciences at Stockholm are about to publish a facsimile of an interesting relic—a photo-lithographic copy of the first edition of the "Systema Naturæ" of Linnæus, a folio of about fourteen leaves. Though very thin, it contains the groundwork of nearly all that the great naturalist accomplished.

MEETINGS FOR THE WEEK.

TUESDAY.—Civil Engineers, 8. Discussion upon "The hydraulic lift graving dock." Royal Inst., 3. Professor Frankland, F.R.S., "On the non-metallic elements." Geologists' Assoc., 8.

WEDNESDAY.—Society of Arts, 8. Mr. Coningsby, "On the late Anglo-French Exhibition, with a proposal for the formation of an Anglo-French Association." Geological, 8. Mr. J. Beete Jukes, F.R.S., "On the carboniferous slate of the North of Devon and South of Ireland." Archæological Assoc., 8½.

THURSDAY.—Royal, 8½. Antiquaries, 8½. Royal Inst., 3. Professor Frankland, F.R.S., "On the non-metallic elements."

FRIDAY.—Royal Inst., 8. Sir John Lubbock, Bart., "On transformation of insects."

SAT.—Royal Inst., 3. Rev. G. Henslow, "On systematic and structural botany."

LATEST PRICES OF METALS.

		£	s.	d.	£	s.	d.
	COPPER.						
British—cake and tile	per ton	95	0	0	96	0	0
Sheet	do	99	0	0	101	0	0
	IRON.						
Pig in Scotland	per ton.	3	13	6	cash.		
Welsh Bars, in London	do	7	15	0	0	0	0
Wales	do	6	15	0	7	0	0
Staffordshire	do	8	10	0		—	
Sheets, single in London	do	10	15	0		—	
Hoops, first quality	do	9	15	0		—	
	LEAD.						
Pig, Foreign	per ton	20	10	0	20	5	0
Red or minium	do	22	10	0		—	
QUICKSILVER	per bottle	7	15	0	7	17	6
	STEEL						
Swedish faggot	per ton	0	0	0		—	
,, Kegs	do	15	10	0	16	0	0
	TIN.						
English Blocks	per cwt	4	11	0	4	15	
Banca	do	4	8	0		—	

PRICES CURRENT OF TIMBER.

Per load—	£	s.	£	s.
Teak	11	10	12	10
Quebec, red pn.	3	5	4	15
yellow pine	2	15	3	10
Memel	0	0	0	0
elm	3	10	5	0
Dantzic oak	3	10	6	0
fir	2	5	3	10
Memel fir	3	0	3	10
Riga	3	5	3	10
Swedish	2	0	2	10
Masts, Quebec,				
rd. pine	6	10	8	10
yellow pine	5	0	6	0
red pine	0	0	0	0
Lathwood, Dant.				
fm	5	10	6	10
St. Peter's	7	0	8	0
Yellow Pine, per reduced C.				
Canada, 1st qual.	17	0	19	10

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Canada, 2nd qual.	12	10	14	0
St. Petersburg yel.	10	10	12	0
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Christiania, per C. 12 ft. by 3 by 9 in. yellow	18	0	23	0
Deck, Plank, Dantzic, per 40 ft. 5 in.	0	14	1	0
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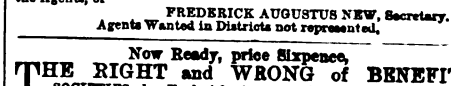

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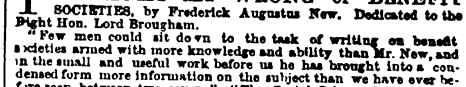

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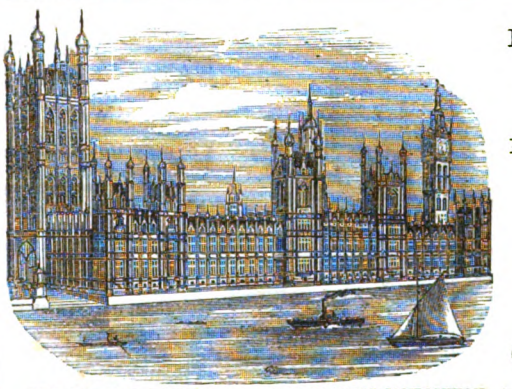

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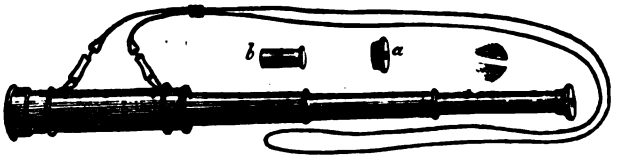

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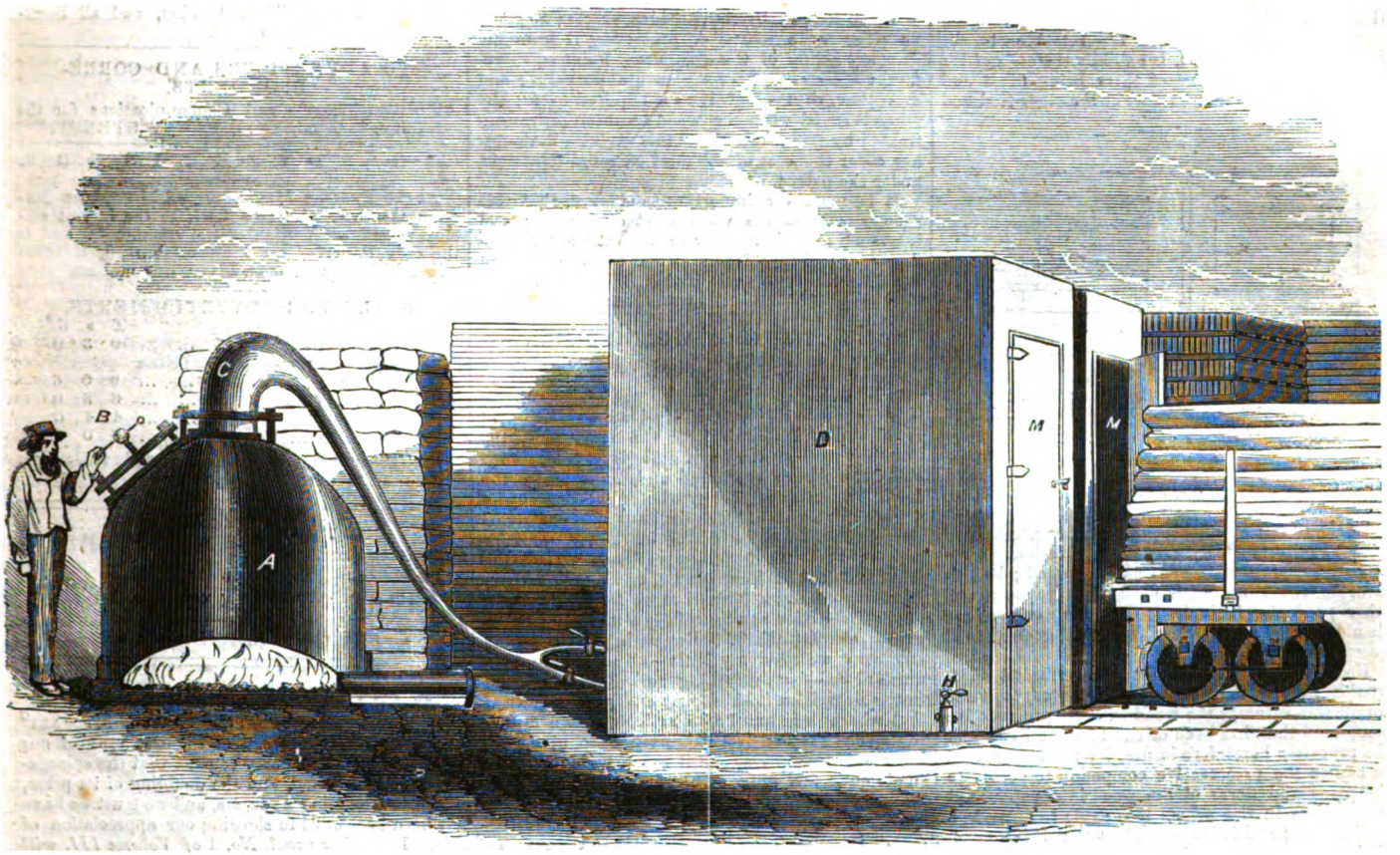
ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

Engineering, Building, Inventions, Electricity, Photography, Chemistry, &c.

VOL. II.—No. 51.] FRIDAY, MARCH 16, 1866. [PRICE TWOPENCE.



ROBBINS'S METHOD OF PRESERVING WOOD.

IT is a well-known fact, says the *Scientific American*, that woods when cut down, and separated from the roots which supply it with its antiseptics, immediately becomes affected by exposure to the heat and the moisture of the atmosphere, the former of which rapidly dissipates the fluid or sap of the wood, while the latter impregnates the woody fibres with substances which the wood while growing, by its antiseptics, entirely excluded. These alternate actions upon the wood gradually and finally cause it to decay. To prevent this decay of wood is, therefore, the object of the present invention, and this object is accomplished thereby. The method consists in subjecting the wood to a preservative process by which nearly all of its antiseptics are retained within the same; and, for those lost, supplying such substances sa will prevent their further waste; at the same time closing the pores, and forming such a combination with the fibres of the wood as will effectually prevent the deteriorating effects of either heat or moisture at ordinary temperatures, or of both upon the same, as hereinbefore alluded to.

Many processes have been heretofore invented for the preservation of wood, some of which were entirely impracticable, while others were only partially successful; but by none could the wood be sufficiently impregnated or saturated with the preservative compound, to insure its preservation for a great length of time, owing to the manner in which the same was applied to the wood.

One form of the Robbins's apparatus for carrying out the improved process is represented in the accompanying plate. A, in the large drawing, represents a retort, made of any desired form or size, in which coal tar, resin, or other oleaginous substances or compounds are placed, and subjected to the action of heat from any suitable furnace. B represents the man-hole in the upper portion of the retort, used in cleansing the same or in changing its contents. C, C, a pipe communicating with retort A, at or near its top, passing to, and

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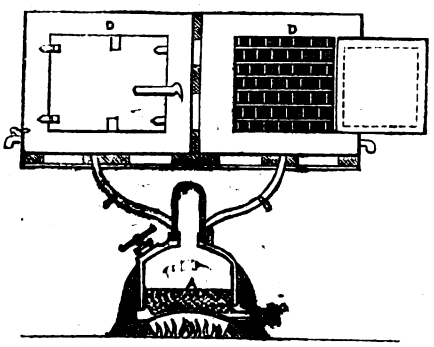
communicating with, chambers or receptacles D. E represents the discharge pipe, employed for removing the remaining contents after the operation is over.

Heat being applied to retort A, containing the coal tar, &c., as described, oleaginous vapours are generated therein, which pass out of the same through the connecting pipe, C, C, into the wood chambers, D, or into only one of the same as may be desired. The heat thus applied first causes the surface moisture of the wood to be removed therefrom, taking the form of steam and condensing on the sides of said chamber, from which it is drawn off through pipes, H, which may be placed in or near the bottom.

Having thus removed the surface moisture from the wood, says Mr. Robbins, I thoroughly impregnate and saturate it through all its pores and fibres by the oleaginous vapours and heavier products of the distillation until it is made impervious to moisture, and so as to entirely resist the action of the atmosphere, when it may be removed from the chambers, D, through the doors, M, M, when the chambers are again to be charged with wood, and so on as long as may be desired.

In this connection we give the outlines of another view of the apparatus, so modified as to adapt it to use in cases where it may be convenient to have the retort and furnace under the chambers containing the lumber. A marks the retort as in the former illustration. D, D exhibits the ends of the receiving chambers, one of them being filled and the door open, while the door of the other is closed

FIG 2



In the operation of this process a temperature of from 212° to 250° Fahrenheit is sufficient to remove the surface moisture from the wood; but, to saturate the same with oleaginous vapours and other products, it is best that the temperature should be raised to 800° Fahrenheit, or higher if necessary.

From the above description it is apparent that, by this process, Mr. Robbins is enabled to more completely saturate the wood with the preservative compound than has been or can be done by any of the processes heretofore in use, for the reason that he causes the preservative compound to permeate the pores and fibres of the wood in a vapourised state, while in the others it is made to enter in a liquid state; and it is also evident that it is accomplished in an economical, expeditious, effective, and practical manner.

The inventor does not intend to limit himself to any particular form of apparatus; nor does he intend to limit himself to the removing of the surface moisture from the wood by means of oleaginous vapours, as herein described, as there are various ways in which the same can be accomplished with the use of heat; but what he does claim as new, and desires to secure by Letters Patent, is:—

The process herein described for preserving wood from mould or decay, the same consisting in first removing the surface moisture from the wood, and then charging and saturating the same with hot oleaginous vapours and compounds, substantially as described.

Also removing the surface moisture from wood by means of hot oleaginous vapours, substantially as herein described.

In this state of extreme attenuation the elements which preserve the wood are more readily admitted, the capillary action being greatly accelerated and made to thoroughly permeate the entire structure of the wood. At the same time the hot vapour opens the pores and expands the wood, so that a larger quantity of the oily compound is admitted. The pores being thus filled, the contraction, which naturally results from the cooling process, seals them, if possible, in a still more effectual and lasting manner. The vast superiority of the Robbins process, as compared with that of Bethell, can only be fairly estimated by those who realise the immense difference between the effectiveness of water and steam in their relations to chemical action and mechanical force.

But we should fail in our attempt to comprehend the full value of this improvement were we to overlook other important considerations. It is to be observed that this process renders light and porous wood as solid and durable as the finest-grained timber, and perhaps equally well adapted to all ordinary purposes in the arts; in fact, it may admit of a question whether the most porous wood may not be made to last even longer than the wood that is least so, from the fact that it absorbs a greater quantity of the material on which its preservation is made to depend.

Wood treated by the Robbins process requires no paint as a means of protecting it from the ordinary action of the elements. Paint is, therefore, useless except for ornamental purposes; and even then, so much of it as is required to fill the pores is saved when the wood has been previously treated by this method, and this saving will doubtless cover the cost of the most effectual treatment under the patent.

It is, moreover, important to observe, that this process seasons the wood most effectually; and inasmuch as it thoroughly protects it from the influence of moisture, it follows that wood so prepared is neither liable to swell, shrink, warp, nor crack.

CITY OF LONDON WORKING MEN'S EXHIBITION.

On Monday, last week, the Lord Mayor opened at the Guildhall an exhibition of articles contributed by, for the most part, the working men of the City. As is usual in such cases, the idea was started and, assisted by the Lord Mayor and other gentlemen, carried out by a few working men. The artisans who controlled the scheme were so successful in their appeals for support that 2,000 fellow workmen signed the requisition to the Lord Mayor, and many of them became guarantors in small sums for the expenses of the Exhibition so successfully inaugurated in the grand old Guildhall. Respecting the opening ceremony we need say little—all such are pretty much alike—but everything worked smoothly. As to the Exhibition itself, it may easily be imagined that where there are 1,035 articles shown (1,000 having been rejected) it is impossible to give even a general description, and it would be invidious to single out a few where all are deserving. It should be understood that the number mentioned does not necessarily represent the productions of working men. Several stands have no *right* there, save as adding to the beauty of the whole; we refer to the advertisement stands of manufacturers and retailers. To these we most emphatically object; while we most gladly approve of the works of art kindly lent by noblemen and gentlemen.

In passing we may remark that the tasteful decorations have produced a "transformation scene" in the Guildhall which it is worth something to gaze upon.

As an Industrial Exhibition this City of London one excels many that we have seen; the general arrangement is highly creditable to the committee, and it possesses features which cannot fail to render it popular among all classes during the five weeks it will be open. Probably if the charge were reduced to half the amount, a fair surplus would be handed over to the committee for the formation of a free public library for the City of London.

THE ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART.
TWOPENCE WEEKLY.

No. 49, March 2:—Phillips's Improved Rotary Spader or Digging Machine, Illustrated.—The Working Man's Franchise.—True Co-operation.—Safes and their character.—The Art of Coining.—London Association of Foremen Engineers.—A Workman's Festival.—Creosoting Railway Sleepers.—On Timber Suitable for Building Purposes.—Photography.—The Spectroscope and the Microscope.—Photo-Panoramic Apparatus.—Road Locomotive.—Art Notes, &c.

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The English Mechanic,
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MIRROR OF SCIENCE AND ART

FRIDAY, MARCH 16, 1866.

A FEW WORDS TO OUR READERS.

The next number of the English Mechanic *closes Volume II.* and the first year of our existence. Here we may remark that the enlargement of the Journal, and the doubling of its price, has been altogether a success, and we trust we have not been backward in showing our appreciation of this. In further proof, *No. 1 of Volume III. will be printed in new type*, cast for us by an eminent firm, which must enhance the value of the Journal to the reader. The Press generally have given us unqualified approval, and men of position frequently, and as a matter of course, now quote the opinions of our valued correspondents in discussion. This must be as much a source of pleasure to them to hear as it is to us to record. In so many instances has this been the case that it would be unfair in us to select any special cases. Sufficient that the fact is so, and that they who have been so quoted are among the working men of the land. In the tens of thousands of our readers—for to that has our circulation sprung—are found the real intelligence of the country; and it is but fair that as much space as possible be afforded for their weekly lucubrations. Our pages are sufficient evidence of our feeling on this point.

An Index to Volume II. is now in hand, and

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will be ready in a few days. It will necessarily be of much greater extent than that to Vol. I., but the price will be only 1d. The price of the cases for binding Vol. II. is fixed at 1s. 6d., and these are now ready.

It may be mentioned here that a great number of complaints have reached us, directed against the keepers of coffee-shops and dining-rooms—supported principally by working men—that those using them cannot there get a glance at the ENGLISH MECHANIC at meal times. We cannot, even if so inclined, force the proprietors of these places to take in our Journal. The only plan is for our readers to keep on demanding it at their hands, and in time they will be certain to have it provided for them; and we shall feel greatly obliged by our readers pursuing this course, and thus assisting in the dissemination of knowledge valuable to all. By mutually assisting each other both will benefit.

To our Advertisers we have to return our thanks, and rejoice at their increase of trade since they appealed directly through our columns to our thousands of practical readers. And we may here intimate that, as we anticipate for Vol. III. a more extensive sale even than has fallen to the lot of Vol. II., our pages must become more valuable to advertisers, and through their medium all will be sure of a certain and liberal return on money expended in seeking notoriety. Again repeating our request that its readers will endeavour to make the ENGLISH MECHANIC, if possible, more widely known than it now is, we have to offer our thanks to all for that publicity which they have already given to it, and the kind regard they have expressed for its originators.

COPPER SMOKE AND SULPHURIC ACID.

WHETHER copper smelters are to become the largest producers of sulphuric acid or not, we think remains only with the copper smelters themselves. That they may be so we think is easily capable of demonstration. Given the collection of the smoke by the smelter, the transformation of it into sulphuric acid is a comparatively easy matter. It is well known that Swansea, as other parts, suffers under a heavy sulphury atmosphere, produced by smelting and other furnaces in it and its neighbourhood. Copper is brought to Swansea because its communications with coal-fields are good; and hence, and for various other economical reasons, it is found cheaper to bring the copper to the coals than the coals to the copper. Swansea has gained greatly by this; but there are few sweets without their accompanying bitters, and smoke, sulphury smoke, is the daily dose of bitters to which Swansea is treated before and after all meals. As a town it has protested as far as it might against the nuisance. Swansea could not well do without the copper, and the copper smelters could not do without Swansea, so civic heads were laid together without arriving at anything very satisfactory; mechanical heads followed the civic example, and the result, as might have been expected, is that the sun may beam clearly on Swansea and on the laden barques going out and coming in with their precious cargoes.

A few numbers back we called attention to the fact that Mr. Vivian had produced a remedy; Mr. Spence has produced another, and between the two it will be hard, indeed, if Swansea be not in time selected for its sanitary purity by invalids, and smelters' open shop in another department of chemistry. Mr. Vivian's plan, or furnace, is not exactly his, for it is the subject of a patent taken out by a German named Gerstenhöfer, the object of the construction of which is to effect, in an economical manner, the roasting of crushed pyrites, for the purpose of driving off the combined sulphur therefrom prior to its conversion into sulphuric acid. According to M. Gerstenhöfer's specification, the furnace is a rectangular chamber, fitted with rows of bars having one of their faces parallel with the top of the furnace, and the rows of bars so arranged that no two bars in succeeding rows shall be directly one over the other. The ore, in a finely-divided condition, is introduced from above, and rotating feed-rollers, fixed in the furnace roof, regulate the supply. The feed-rollers being placed over the first row of bars, as the ore falls through it is piled up on them until it falls over on the row of bars below; and the supply from above being kept even, the whole furnace is filled gradually. In the side of the furnace, between the feed-rolls and the bars, are channels, by which escape the products of the calcination; and there are other apertures which may be opened for cleaning the bars. Below the tiers of bars there is an open space, into which some ignited fuel is introduced at the commencement of the process of calcination; and this fire is well fed with wood or charcoal until the charge of ore is well ignited, when the grate is withdrawn, the charge continuing to burn by means of the sulphur which is being continually extracted. A current of air forced up through the furnace keeps up this combustion, the products of which are taken over through the channels in the top of the furnace to the sulphuric acid chambers. It may be noted here that the conditions of the calcination are governed by the height of the furnace; also that the channels, by which the gases are taken over, are arranged so as to heat the cold air forced into the bottom of the furnace to promote combustion. The calcined ore passed through the furnace falls into a space below, whence it is transferred to the next operation.

Herr Gerstenhöfer claims for his invention the following among other advantages:—"First, the ores are operated on in a very divided state, so as to expose a large surface to the action of the air, and this surface is always being renewed; second, the air which must be admitted is forced to come perfectly into contact with the ores; third, the ores are brought into the furnace by mechanical means, continuously in such quantities as may be required, so as to maintain a continual roasting process; fourth, the air or draft is also brought into the furnace by mechanical means, in order to be able to regulate the draught, according to the quantities of ore, and also to prevent the influence of storms, which are sometimes very troublesome in working with grate surfaces; fifth, the heat produced by the ores is not led away uselessly by the gases, but is employed to heat the new ores and the air."

On the face of it, this patent arrangement looks well, and there is no doubt but that it will answer for certain classes of ores—those rich in sulphur and which can be calcined without the perpetua presence of burning fuel. One objection, of forcel is the necessity entailed on those using the furnace to have the ore crushed to a very small gauge. Of course, the blast will require attention; and, granted that the ore can be ground to suit the furnace, and that the furnace itself can be cheaply built and kept in repair; then the success of Mr. Vivian's *protégé* seems secured beyond doubt, for the classes of ore with sulphur largely contained.

Turning now to Mr. Spence's patent for "improvements in economising the manufacture of sulphuric acid, and in obtaining copper from ores used in such manufacture, whereby he is enabled to extract a larger portion of sulphur than has hitherto been practicable, which sulphur, passing off as sulphurous, is converted into sulphuric acid"—we find ourselves confronted first of all by a tremendously long furnace. It is from forty to fifty feet from end to end. The fire, placed at one end, stretches right across the furnace—the smoke and flame from whence are passed along a space under the bed of the part of the furnace devoted to calcination, which is separated from this "space" by a thin partition of firebrick. Thus the furnace is composed of two chambers—the upper containing the ore to be calcined, the lower to act as a viaduct for the proceeds of combustion to the separate chimney;—and, it will at once be observed, the calciner is heated without the gases evolved from the ore being mixed with smoke from the fire. In the fire chamber there is but one opening—that for the fire at one end, the chimney being at the other; but the calcining space has several apertures communicating with the outer atmosphere. When the roasting begins ore is introduced through that aperture which is most distant from the fireplace; and this batch is spread out over the floor of the furnace at that part. This being heated for the required time is pushed forward opposite the second aperture, and then a fresh lot of ore is pushed in through the first opening. This is carried on, each lot being shifted forward, until what was introduced at the end furthest from the fire reaches the hottest part over the fire, when the sulphur is separated and the ore passed on to be melted. This is effected through an opening at the fire end, where there is a small channel to admit a current of air which is continuously forced in during the calcination, and not only assists the work of roasting, but in carrying off the sulphurous acid through channels made for its escape into the acid chambers. As a guide in roasting Mr. Spence says: "The degree to be effected, so as to secure the best results, can be ascertained only by experience; but I may state by way of guidance, that working with a furnace fifty feet long, and with twelve doors, I allow the first charge to remain for an hour, then transfer it to the second position, and put a fresh charge into the first, and so on, waiting an hour between each charge."

Various modifications have been patented by Mr. Spence—but we have little faith in them. We stand by the one now under notice, as probably in the end will Mr. Spence. It has this advantage over Mr. Gerstenhöfer's, that it is suited for all sized ores and will do all the present furnaces can do. Men, however are required to attend Mr. Spence's furnace—boy can do the work of the other. Mr. Spence's furnace will consume a large quantity of fuel, the other, it is stated, does not. But Mr. Spence's furnace will turn out more work than any other furnace in existence. Furthermore, Mr. Spence's furnace has been and is working; we have yet to learn the results of the other from Mr. Vivian. Both have their advocates, and probably it will be found that, if it will pay to finely pulverize sulphurous ores, that both are suited to the work of ore calcination and carrying over the products of combustion; and so rid Swansea of a gigantic pest, and add a heavy percentage to the profits of the holders of as close a borough as ever existed in free England.

ON PIGMENTS.*

I.

THERE is no point more deserving the amateur decorator's attention, and perhaps none more neglected than the properties and nature of the pigments he employs. So long as a dry smooth absorbent base is attained, both amateurs and professionals alike, too often think that no further care is needed, and either from ignorance or wilful carelessness, employ pigments of the worst possible character, reaping their own reward in the speedy fugacity and ultimate destruction of their work. Unfortunately, a bad example is but too frequently set them by the practice of many artists, who sacrifice permanence for mere temporary effects, and employ lavishly delicate tints which for a time delight the eye, but all too surely ultimately fade, blacken or change to the destruction of the picture. It is to be regretted also that as a general rule the permanence of colours is in almost inverse ratio to their beauty, the solid grave ochres, umbers and siennas being durable, while the brilliant lakes, scarlets and greens quickly fade and fly. At the same time, however, we must bear in mind how greatly the science of the chemist has of late years aided the labour of the artist, in supplying him with pigments free from the bane of fugacity. Indeed, thanks to the chemical science, so greatly has the palette been extended by the addition of pigments, both permanent and brilliant, that it will be the artist's own fault alone if he employ fugitive tints in preference to those of more durable qualities. It should then be the decorator's business to make himself well acquainted with the nature of the colours with which he has to deal, more especially it should be an absolute and invariable rule never

* From "The Art of Mural Decoration." Winsor and Newton, 38, Rathbone-place.

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to employ any pigment of the durability of which he is not sure. It was this thorough understanding of the qualities of their colours, added to a severe simplicity in their employment, which ensured to the artists of the Middle Ages the combined brilliance and durability of their paintings. And yet, while in the present day our chemical knowledge has developed and increased so marvellously, while all the matériel of the artist has been brought within the reach of the most moderate purse, and while the practice of the art has been freed from the atmosphere of mystery which once enveloped it, so great is the general ignorance of decorators, and so reckless their system, that there is scarcely any grounds for expecting the permanence of modern decoration. Though it would be easy to point out specimens of decorative work which have stood the lapse of four centuries with brilliance unimpaired, five or six years is very often sufficient to change, impair, and perhaps destroy modern adornment. When artists or professional decorators speak regrettingly of lost "systems" or pigments enjoyed by the mediævalists and unattainable now, it would be far better were they to make the best use of existing materials and study their further developement. "Titian," says Haydon, "got his colours from the colour shops on the Rialto, as we get ours from Brown's; and if Apelles or Titian were living now, they would paint just as good works with our brushes and colours as with their own." Naturally, where the artist was his own colourman, that is prepared his colours from the materials selected and purchased from the merchant, he would take every care that such preparation should be the best possible, knowing how far his fame depended upon it. We may also believe that, to a certain extent, religious motives may have directed the employment of the finest pigments on sacred art. "I give you this advice," says Cennini, "that you endeavour always to use fine gold and good colours, particularly in painting representations of our Lady. And if you say that a poor person cannot afford the expense, I answer, that if you work well (and give sufficient time to your works) and paint with good colours, you will acquire so much fame that from a poor person you will become a rich one; and your name will stand so high for using good colours, that if some masters receive a ducat for painting one figure, you will certainly be offered two, and your wishes will be fulfilled, according to the old proverb, 'good work, good pay.' And even should you not be well paid, God and our Lady will reward your soul and body for it." So that the amateur decorator appears bound to employ good pigments, either from a religious or practical motive, as his fancy or experience may suggest. In the present day when good artist-colourmen abound, and the aid of the chemist is called in to the birth of a new pigment, we could scarcely venture to recommend the amateur to manufacture his own colours. The excellence of their preparation, whether in oil, water or powder, he may generally take for granted, their permanence and eligibility should be ascertained by his own private study. If an artist chooses to employ such colours as iodine scarlet, pearl white, or verdigris in decoration, he has only himself to thank when they turn black or fade; the fault is not with the colourman for supplying, but with the artist for using pigments radically vicious. For any deep and comprehensive inquiry into the natures of colours, we must refer the reader to that useful work, Field's "Chromatography," where all particulars may be learnt. In the present chapter, we only aim at giving a few rough notes on the properties of those pigments most useful for decorative purposes, with the addition of the media most applicable to each. The colours really indispensable for decoration are very few, and happily those are mostly of good character for permanency. It should be carefully borne in mind, however, that the permanence of most pigments is influenced to a great degree by circumstances. Thus a colour which is highly eligible in oil, may be doubtful in distemper, and absolutely inadmissible in fresco; and *vice versa*, many colours useful in tempera do not admit oil. The limited palette again of fresco is owing to the presence of lime, which is destructive to vegetal colours, but has no influence upon the earths. So also one colour may be antagonistic to another, and render it fugitive in conjunction or juxtaposition, whereas separate, each may be regarded as permanent. But besides all these considerations, and putting aside the question of internal damp which destroys all colours and all media alike, the decorator must take into his calculations the adverse influence of external damp (from condensation of breath) and the action of light, oxygen, shade, sulphuretted hydrogen or foul air, and he will find, perhaps somewhat to his confusion, that some pigments are entirely uninjured by one class of hostile chemical agents, but perish under the reverse, that some are proof against neither, and that others can defy both. In the words of Mr. Field, "The majority of pigments have a mediocrity of qualification, balancing their excellencies with their defects, and the number of good and eligible pigments overbalances those which ought in general to be rejected."

Aureolin.—This new and very beautiful pigment possesses a rare combination of remarkable qualities that place it far above any other known brilliant yellow. It is light, vivid, and transparent. The lighter and fainter tints are at once clear and delicate, and admit the most subtle gradation of tone. Aureolin mixes advantageously with all other colours, and forms combinations of the utmost variety and value; the tints of Aureolin being of exceeding purity, whilst its hue is rich and vivid. It is absolutely and entirely permanent. Aureolin has been subjected to every variety of the severest test and trial which have demonstrated its powers of endurance, and shown that its distinctive characteristics are retained unimpaired under all possible conditions.

Cadmium Yellow. Sulphide of Cadmium.—The are several tints of Cadmium Yellow manufactured. That called "deep" Cadmium is the most serviceable and is chiefly in use. It is a full, rich, golden yellow, not very transparent, but clear and bright, and of great power. It gives beautiful clear tints by admixture with white. It is the most richly toned yellow known. It may be classed among the permanent pigments; impure air or damp does not affect the yellow of Cadmium.

PERSPECTIVE IN ITS APPLICATION TO ARCHITECTURAL DESIGN.

II.

We have now briefly considered the first and most simple elements of the science of perspective, I will therefore say a few words on what I think you will agree with me in deeming rather important in its bearings on architectural design.

You are fully aware of the necessity of correctly delineating a design upon paper geometrically, and whilst doing so I am sure your thoughts have wandered more or less into the realms of fancy, as to its probable effect when executed; but thinking on such a subject without some knowledge of the art of perspective, or, in other words, seeing things as they really will appear, too often ends in disappointment. I do not mean to infer that this power of anticipating the probable effect will cure a bad design, but rather that it will most likely prevent its being made at all. I, therefore, wish to bring before your notice some simple facts, tending to make the drudgery of office work somewhat less disagreeable than it usually is.

Whether we contemplate the broad expanse of the boundless ocean, the undulating landscape, the lofty mountain, or the constructive works of man, each are seen subject to the laws of perspective. Take, for example, the mighty forest, stand immediately in front of some giant tree; it appears comparatively uninteresting, but look at in connection with twenty, fifty, or a hundred others, and the impression, at one glance, is increased more than as many fold. Now, if we could only see one at a time we should not experience much sense of expanse and grandeur, but seen in what we call perspective, every object seems changed from what we may positively know it to be, and changed for the better. We will suppose the trunks of two of these trees to be columns, only I must ask you to imagine one square and the other round, of equal diameter, drawn geometrically, the one could not be distinguished from the other, unless by the help of a bit of artistic shading; draw each, however, as it appears, *i.e.*, in perspective, and what grace do we perceive in the one as compared with the other—the square one turning out a heavy clumsy looking object, whilst the round one may have all the proportions of the Corinthian shaft. Again, take a cube, an octagon, or a cylindrical figure; draw them as before geometrically, and they will each appear pretty much alike, but consider each in relation to its actual appearance when occupying some important position in the composition of an architectural design, and what a change will have apparently taken place. I must leave you to draw your own inference from this, considered in reference to its bearing upon large works designed in the usual way, and what I wish particularly to convey is this—that I think we should always consider at least two elevations at the same time, or the result will, in nine cases out of ten, be other than was intended or hoped for; for the one side may appear very satisfactory, well-proportioned, &c., perhaps founded on the very best examples, and yet if treated as by itself without duly considering certain little accessories, such, for instance, as its principal projections and recesses, the result will be a partial, if not a total failure, and next to actually having the design modelled in relief I know of no nearer approach to truth than what is afforded by a judicious use of the rules of perspective. For I think it bears such an important part in all the architect has to consider, apart from the mere utility of his design, that a projection cannot be made, an opening pierced, or a set of mouldings grouped with any degree of certainty, without some knowledge of it being brought to bear upon the subject, for his work when executed and subjected to the various impressions conveyed by the laws of optics must be viewed according to its rules.

For example, we will suppose ourselves engaged in designing a building containing several distinct general features or masses of outline both as regards plan and elevation, presuming the whole range to be 100 feet long, with a centre and two wings, each having considerable projection, and that at the junction of the central projection with the main range, a dome or other large mass is to be erected, and that the whole work can only be seen from a comparatively near station point, the whole work may appear exceedingly satisfactory as a geometrical elevation, but when tested by the rules of perspective it would very likely be found that, 1st, one or more of the projecting wings partially or entirely obscured the intermediate recessed portion or considerably more of it than the designer intended, and in the case of the dome or other elevated portion upon which perhaps the greatest care had been bestowed, it might probably be found that its best features hardly appear above the gables or the ridge of the roof. On the other hand, by keeping in mind whilst at work the conditions under which the building will be seen, that is, the principal station point, together with the surrounding objects already existing. The mistake of putting in elaborate and expensive details, only to be seen by going round a corner in the one case, or by being carried up in a balloon in the other would, to a great extent, be avoided.

You will perhaps suppose that to discover all this at the outset would be difficult and unnecessary; my answer to which is, try in perspective for yourselves the effect of any given work upon which you may chance to be engaged under similar conditions to these above alluded to, and ten to one you will not only experience the desire to alter the proportions of the most important masses as well as the principal details, but very likely the entire arrangement in reference to the grouping; nor is the discovery of all this a difficult matter, when even the first principles of the art under consideration are mastered, as the general outline as well as the chief details may be thrown into perspective in a very short time, for mere lines representing the main features, such as the most projecting angles, the sky-line of gables, pedi-

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ments, &c., the deepest recesses and even the main cornice may all be found sufficiently accurate as to afford such an idea of the whole as will enable the designer to avoid many points in themselves totally unnecessary to the composition, and to alter others he may deem objectionable.

In conclusion I will ask you to suppose ourselves in search of the best station point from which to view St. Paul's Cathedral; you get a good one as you approach from Fleet-street, but what you wish to see you find yourself too much in front, and getting nearer, the dome begins to vanish behind the western pediment—perhaps you are enamoured with the beauty of the details on a still nearer approach; but still what you are in search of you do not find to your satisfaction, namely, such a point of sight as from which the greatest amount of its general mass, and at the same time its most important subordinate parts and details can be taken in at one view, and at last you may find that such a one can only be obtained by making use of one of the river steamboats, or crossing over one of the thronged bridges to the opposite bank, or possibly by ascending "the Monument." Now all these various views of a building as yet existing in the mind of the architect only, can be tolerably well defined upon paper by the judicious use of perspective as will enable him to suit his design to the circumstances of the site in reference to the position of the spectator or station point.

TELEGRAPHY.

Improvements on Bonelli's System.

It has been urged by many that ere Bonelli's system could be made to pay, and hence become better known among us, it would have to undergo various modifications, which it is not our purpose here to specify. What we require is information as to whether anything has been done in the matter by Mr. Whiteside Cook, of Angel Court, Throgmorton Street, further than the obtaining simple provisional protection for his scheme, brought out twelve months since. Mr. Cook, by the way, was simply an agent of Gaetano Bonelli, of Turin, who had determined to take the bull by the horns, and so save other folks the honour and the profit. The improvements in typo-telegraphy at that time registered were intended to enable the scheme to be worked with one wire, but with, in this respect, the same apparatus—the message, however, being printed in symbols instead of in Roman characters, as is the case when several wires are used. The symbol types are fitted to the instrument in precisely the same manner as are the ordinary types, and the apparatus is worked in the same manner. The signals, in the proposed system, are produced on prepared paper by means of an electric current transmitted through the form of the characters, which are connected with a conducting wire, or with the earth, and passed under two teeth connected with different poles of two batteries, the two remaining poles of the batteries being connected with the earth, if the type be connected with the line, or with the line if the type be connected with the earth, and so arranged that when the type come in contact with either of the aforesaid teeth, a circuit is completed through the line, which at the receiving end is connected by means of the receiving instrument with the earth. The invention (always using one wire only) substitutes a second line of dots for the dashes of the Morse system; and thus is formed the symbolic alphabet, with which it was contended greater rapidity and correctness could be reckoned upon than under the original system of transmitting messages.

The types used for the purposes of the improved system are provided at one end, or on one side, with letters of the ordinary characters, and at the other with the conventional symbol, consisting of an arrangement of dots which it is intended to produce on the prepared paper at the receiving station. The types are "set up" with the ordinary characters uppermost, so that the message may be read before the types are placed in the telegraphic apparatus, and thereby, provided the types are properly set up, the risk of mistakes is reduced to a very low minimum. The types are then turned upside down, or over, and the symbols transmitted by the telegraphic instrument.

The use of two batteries at the sending station renders possible the production of two lines of dots at the receiving station, in the following manner:—The arrangement of the parts above described being made at the sending station, the prepared paper at the other end is laid on an insulated conductor and passed under two teeth, the one connected with earth, the other with the line. Now, if a point on the transmitting type comes in contact with the tooth connected with one battery, a positive current will be sent down one of the teeth resting on the paper at the receiving station and up the other; but if the contact at the sending station be made by means of a point coming into contact with the tooth connected with the battery, a current will be sent in the opposite direction—that is to say, down the tooth at the receiving end, up which it passed in the other case; and as only a positive current passing down a tooth into the paper will produce a mark, the dots will be produced by the one or the other of these points, according as the contact at the transmitting end was made by a point in the line passing under one tooth or in that passing under the other; by this means, it is believed, the required symbol will always be reproduced at the receiving station.

To ensure greater clearness and certainty in the production of the marks, M. Bonelli purposes to adopt a battery arrangement, such that the line shall be always maintained in a state of dynamic equilibrium. This arrangement is well known to electricians. This arrangement is intended to replace the system of counter-currents, used when the system is worked with several wires.

Now, if it is possible to do what M. Bonelli purposed doing, why is it we do not hear more of the projected plan? Our only object in devoting space to the matter here, is to glean information for such of our readers as are interested in electric telegraphy, with which we hope M. Bonelli will kindly furnish them.

PREPARING OBJECTS FOR THE MICROSCOPE.

At a recent meeting of the Manchester Microscopical Society, the Secretary reported that he had made a catalogue of the collection of microscopical objects belonging to the Section.

Mr. Sidebotham remarked on the best cement to use in forming cells for fluid preparations, and stated that gold size appeared to prevent the entrance of air bubbles better than Japan varnish or Brunswick black, which latter in time became porous, and also, from the evaporation of its turpentine, brittle. He said he and Mr. Thwaite were perhaps the first to use this method of mounting objects, and that he possessed slides of gold size cells made in 1844, which were still quite perfect, while those he mounted with Japan black in 1850 were most of them spoiled, and that he had again reverted to the use of gold size for the formation of the cell, using Japan varnish for its final closing only.

The Secretary said gold size remained viscid for a long time, and that if the cells formed of it were not well dried for a considerable period, or even baked in an oven, the size was very liable to "run in" and spoil the preparation. He had re-varnished the Section's collection with a mixture of Japan varnish and gold size, and thought the gold size would prevent the Japan varnish from becoming brittle or porous, while the latter would prevent the gold size from running in; but he strongly recommended that all collections should be re-varnished every five years, and deprecated the use of covering papers on slides of fluid preparations, as it prevented this.

Mr. Latham recommended the addition of a solution of india-rubber.

Mr. Heys showed a well-mounted specimen of he exuvium of the larva of a Dragon Fly, and stated he found these insects were easily brought tto cast off their skins by changing the water i which they were kept—if soft, to hard, and *vice versa*, or if muddy, to fresh.

IMPROVEMENTS IN THE MANUFACTURE OF IRON.

Of all the metals employed in the arts and manufactures perhaps none have been more variously treated than iron. Amongst the most recent improvements in its methods of manufacture may be mentioned that of Mr. E. H. Newby, of Cheapside, who adds to pig or cast-iron an alloy and a flux for the purpose of increasing its strength, and rendering it less liable to corrosion. The alloy is composed of copper, tin, zinc, and aluminium. The flux is composed of carbonate of baryta and fluor-spar or cryolite. The following is the manner in which the process is carried out:—The melted iron is tapped from the blast or other furnace or a ladle, into which has first been put the flux—for 1,000 lbs. of cast-iron 5 lbs. of carbonate of baryta and 5 lbs. of fluor-spar or cryolite. This flux tends to remove from the iron sulphur and silicon, both of which are injurious to its quality. The iron having been tapped into the ladle on to the flux, the ladle is covered closely with a hood of sheet-iron, from which a pipe or flue leads off any zinc fumes which may be generated, and these may be collected if desired. There also passes through this hood an earthenware pipe, and its end dips just below the surface of the melted iron in the ladle. The alloy is then poured down the clay pipe into the ladle, and the pipe is then immediately closed by a valve or stopper at the top. At the time of pouring in the alloy the iron should not be too hot, but at about the heat suitable for casting into sand moulds. After the alloy has been added, and when any boiling or action which results has subsided, the iron is cast into pigs, and these are re-melted for use in a cupola furnace, and castings are made from it as from ordinary foundry iron.

The alloy is prepared in the following manner: If the quality of the iron be that known as "white iron," for each 1,000 lbs. of iron there is melted in a closely covered crucible 25 lbs. of zinc, 2½ lbs. of tin, 5 lbs. of copper, and 1-5th of a lb. of aluminium, 2 lbs. of borax, and 1 lb. of permanganate of potash being added as a flux. When the whole is fused, melted cast-iron is poured in, until (say) four or five times the weight of the charge in the crucible has been added, and the whole is then together poured into the cast-iron in the ladle, in the manner already described. If the iron to be treated be grey cast-iron, the alloy should by preference be composed as follows:—From 30 lbs. to 60 lbs. of zinc, 5 lbs. of tin, 5 lbs. of copper, and 1-5th of a pound of aluminium. It is preferred to employ in combination the two processes of treating cast-iron, first, with the flux of carbonate of baryta and fluor-spar or cryolite; and, second, with the alloy of copper, tin, zinc, and aluminium. The processes may, however, be used separately. The improvements in the manufacture of wrought-iron consist in the addition to the iron in process of manufacture, and whilst it is in the converting or puddling furnace, of a mixture of black oxide of manganese, oxide of zinc, chloride of tin, carbonate of baryta, iron filings, and fluor-spar. These materials are made into small balls with gas tar or asphaltum, and are thrown in during the boiling of the iron and before it is balled. For 1,000 lbs. of cast-iron there are employed 10 lbs. of oxide of manganese, 30 lbs. of oxide of zinc, 5 lbs. of chloride of tin, 10 lbs. of carbonate of baryta, 5 lbs. of fluor-spar, 5 lbs. of iron filings, and 10 lbs. of gas tar or asphaltum. The wrought-iron produced is very strong and pliable, and little liable to be corroded by acids.

A Telegraph Line Six Thousand Miles Long.—The telegraph has lately been extended far up Fraser River *en route* for Russia, and is now in working order from New York *via* San Francisco to a point 400 miles above New Westminster on Fraser River, making in round numbers about 6,000 miles.—*Panama Star.*

It has been stated that the beds of rock salt were the result of volcanic agency, rather than deposits from the ocean.

The aurora borealis and earthquakes predominate strikingly in the years when the spots on the sun are numerous.

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Photography.

ON A NEW CAUSE OF PINHOLES AND STREAKS, AND ON THE ACTION OF NITRATE OF BARYTA IN THE NEGATIVE BATH.*

Among the many defects in the negative process, none are so frequent as pinholes in the collodion film. Every photographer is familiar with these troublesome spots, which are most prone to make their appearance in the case of old silver baths, and the chief cause of which, apart from dust, is the iodide of silver dissolved in the bath, which finally (when the bath is saturated with it) tends to crystallise in combination with the nitrate of silver, adheres to the collodion film whilst in the bath and during the development, and finally leaves behind a small hole, at first scarcely visible, but coming out more clearly by contrast when the print is strengthened.

Two years ago we devoted special attention to these precipitates of iodide of silver, and made several remarkable observations which threw light upon the action, hitherto in so many particulars obscure, of old silver baths.

We showed at that time that iodide of silver is less easily soluble in heat than in cold, and that, therefore, on hot days silver baths soon become turbid and grow clear again by simple cooling. We also showed that iodide of silver is more easily soluble in acid and alcoholic baths than in those containing only pure water and the silver salt.

Hence was easily explained the formation of pinholes in the heat of summer, or after the neutralising of the bath; and our friend Mr. Wharton Simpson showed the correctness of our results in a series of comparative experiments.

Singular phenomena still, however, presented themselves, which could not be harmonised with this theory of the formation of pinholes.

Herr Kurths, of Magdeburg, wrote to us that, at a low temperature (4°), he had found pinholes, which, on warming the bath to 12°, disappeared. A similar announcement was made to us by Dr. Lorent, of Mainheim.

The combination of iodide and nitrate of silver could not be the sole cause of these phenomena, for at a low temperature it not only does not precipitate itself, but even dissolves, as may easily be observed on the cooling of a bath that has become turbid in the heat.

We sought the further cause of the defect in other salts scarcely soluble, which dissolve less readily in cold than in heat, and must therefore precipitate themselves on cooling; the acetate of silver, for example, which originates so easily in the bath through the adding of acetic acid, or through the decomposition of the alcohol contained in it.

Of course such a secretion of crystals of acetate of silver on the collodion film has been repeatedly observed by us and others. These, however, occasion not so much pinholes, as "spears, crosses, and swords," the needle-shaped crystals attaching themselves to the film either singly or with several crossed together, and hindering the action of the light.

Our attention was lately directed once more to this point by a letter from Herr Kruger, of Schwerin. He sent two samples of crystals which had precipitated themselves in his silver bath, and wrote that he had been annoyed the whole summer by pinholes, which often appeared after two days' use of a new silver bath, even when it contained little iodide of silver. The crystals in question had secreted themselves on the evaporation of one of the baths.

I examined the crystals, and found, beside iron and a few splinters of glass, a considerable quantity of sulphate of silver.† This result surprised me, as I did not at once suspect the source of this impurity. A second letter from Herr Kruger gave the necessary explanation, informing me that in the examination of the spoiled baths he had likewise discovered sulphuric acid, and that this arose from the *impure iodizers* which he had applied. At the same time he sent me the iodizers mentioned, and the impure bath, and there I found indeed sulphuric acid along with carbonic acid (in the iodizer).

The source of the sulphuric acid in the bath was now discovered. A part had got in the bath at first by iodizing it with a little iodide of potassium. Every new collodion plate had increased the quantity of it, and the most probable supposition was that the salt, with its known difficulty of solution, had rapidly precipitated itself, and occasioned the pinholes.

In order to test whether the sulphate of silver really occasioned pinholes I made a silver bath 1·10, and mixed this with ¼ per cent. of iodide of potassium, and tested it. There were *no pinholes*.

To 200 cubic centimeters of the bath were now added 0·8 grain of sulphate of soda. A considerable precipitate of sulphate of silver was formed. This was filtered, and in the filtered bath a plate was made. On sensitizing, it appeared covered with small crystals, and after being exposed to the light and developed, it swarmed with little pinholes.

Here, however, a considerable quantity of silver (about 4 per cent.) had been precipitated as sulphate, and there was reason to suspect that thereby the power of solution for iodide of silver might have been lessened, and thus the pinholes caused. I therefore repeated the experiment, taking 200 cubic centimeters of a new freshly-iodized bath, and shaking it with fixed sulphate of silver. Here the quantity of nitrate of silver remained the same.

Only very little sulphate of silver was dissolved, and I obtained a bath which contained of sulphuric acid much less than that of Kruger, and also gave but few pinholes. During the night, however, the bath cooled considerably, and next morning it gave numerous pinholes.

The cause, however, might still be laid on the iodide of silver which was present. I therefore made a third bath without iodide of silver—200 cubic cent. of water, 20 grains of nitrate of silver, and 0·5 grain of sulphate of soda; a precipitate of sulphate of silver was thereby formed. The whole was now heated to 90° C. Notwithstanding this, the precipitate dissolved with extreme slowness, and even after an hour and a half there was still a small residuum—a proof that 100 cubic cent. of a silver bath 1·10 at 90° C. is hardly capable of dissolving ¼ grain of sulphate of silver. A further addition of 0·5 grain of sulphate of soda was made, the evaporated water replaced, the whole filtered, and allowed to cool for twelve hours. Small crystals had then secreted themselves on the surface. Several prints made in this bath showed very numerous pinholes. Now this bath was free from iodide of silver, apart from the small quantity which is dissolved in sensitizing; the pinholes accordingly could *not* proceed from it. It is therefore established beyond all doubt that pinholes are occasioned by sulphate of silver.

I observed, moreover, in the case of this bath, another remarkable phenomenon, viz., clear, worm-shaped lines. These lines reminded me strongly of an incident which occurred in the Photographic Association. Herr Benque exhibited at the session of the 17th of March several prints, upon which quite similar lines were visible. Nobody was able at that time to give a satisfactory explanation of the phenomenon; Herr Schippang and Herr Prümm ascribed it to the iodizers.

I believe that I can now, with tolerable certainty, assign as the cause of these strange phenomena the presence of sulphate of silver, and it may be that this has been produced by the impure iodizers. The matter induced me to examine several of the commercial samples of iodizers, and I readily found in these sulphuric acid and carbonic acid.

There are, besides, other sources of sulphuric acid in photographic baths. It may proceed (2) from impure nitric acid, which was employed in the dissolving of the silver (as Herr Kruger has already asserted); (3) from acid pyroxyline; and (4) from impure blotting paper. The latter not seldom contains sulphate of lime, and also sulphate of soda, as a residuum from the bleaching process with antichlor.

It is obvious, therefore, that the presence of sulphuric acid in photographic chemicals is much more frequent than one would suppose, and it appears to me highly probable that the formation of pinholes in cold weather (as observed by Herr Kurths and Dr. Lorent) proceeds from it.

These experiences may induce manufacturers to direct their attention to this, hitherto entirely overlooked, the presence of sulphuric acid in photographic chemicals; and we advise photographers to test their chemicals themselves for it.

This is best done with the aid of nitrate of baryta, which is to be added to a solution of the substance to be tested, acidified with a few drops of nitric acid. The presence of sulphuric acid betrays itself by producing a turbidity. To test, in this way, silver baths containing iodide of silver in order to detect sulphuric acid, requires caution, since iodide of silver precipitates itself, and likewise occasions turbidity; two or three drops of nitric acid should be added to four cubic cent. of bath solution, in order to prevent the precipitation of iodide of silver, and not till then a few drops (as few as possible) of nitrate of baryta solution. The turbidity does not show itself for some time. It is better, however, to precipitate the silver with pure hydrochloric acid, to filter, and then to test for sulphuric acid.

Now I tried, by mixing with nitrate of baryta, to precipitate the sulphuric acid in the negative baths which contained the latter, and which produced pinholes. In connection with this, I made a remarkable observation.

I added 0·8 solid nitrate of baryta to the first bath (200 cub. cent.), shook it, and let it stand till the next day; then filtered off the sulphate of baryta which had been produced, and made a print in the bath. This showed now no pinholes, but an *astonishing intensity* immediately after development, so that it could be printed immediately without any strengthening. The plate appeared only a little hard.

The bath contained, as I establish by examination, a little barium.

The second bath, containing sulphuric acid (it contained 0·25 per cent. sulphate of silver), was now mixed with ¼ per cent. nitrate of baryta, and treated just as above.

The result was the same. I obtained a plate of *extraordinary intensity*, somewhat hard in the lights, but with many fine details in the shades (of the original), finer than with an ordinary bath. The intensity of the plates made in the second bath surpassed that of those made in the first (which also contained less barium).

I must conclude from these experiments, several times repeated, that nitrate of baryta in the negative bath increases remarkably the intensity of the plates.

It should only be added, however, in a very small proportion to the silver bath, for it belongs to the salts which are difficult of solution in water, and which are precipitated in crystals by alcohol.

If a bath, therefore, contains much barium, the latter is precipitated by the alcohol of the collodion film, and occasions, like all precipitates of that kind, *pinholes*. With longer use of a bath containing much barium, these pinholes would appear to a remarkable extent.

* Dr. H. Vogel in the *Photographic News*.

† Mr. Mayall recently mentioned to us that, as a result of the examination of an old and imperfect bath, sulphate of silver was found in it.—Ed.

Window for Dark Room.—In preparing a window for the illumination of a photographer's dark room, Obernetter mixes an acid solution of sulphate of quinine with some gum or dextrine, and paints the mixture over a thin sheet of white paper. With this he covers the window panes, and he states that on the brightest day a window so prepared will allow no actinic light to pass.

Flame is a conductor of electricity.

Goitre and cretinism usually occur in those localities where iodine is most wanting.

The first furnace in South Wales for the reduction of iron ore by pit coal was set up at Dowlais.

The produce of sugar in the Bengal Presidency in 1864 was only a third of what it had been thirteen years earlier.

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THE SYSTEM OF THE UNIVERSE.*

The astronomical evidences of motion are clear and palpable to the most superficial observer, and yet a long experience has shown that the right way of interpreting these evidences does not lie upon the surface, nor even flow from the most careful observations extended over any conceivable length of time; indeed, the admission that to Copernicus is due the honour of discovering the motion of the earth—a fact which otherwise should have been handed down from the earliest ages as an obvious truth—places this beyond doubt.

Although the motion of the earth is now a recognised doctrine, the evidence upon which its reception as a scientific dogma rests deserves careful study, as it must form the groundwork of all further advance. It is drawn from three sources. The difference in the length of the sidereal and solar day; the difference in period between the sidereal and lunar month; and the annual passage of the sun round the zodiac.

The first and second of these are separate but coincident illustrations of the same principle—that when an axis of rotation or focus of revolution is itself moving in an orbit, a given radius extended from the axis or focus regains its parallelism in space, or completes a single full revolution, before resuming its primary relations of conjunction.

The experimental demonstration of this principle is extremely simple; for if the reader will stand before a round table with a straight line drawn from himself across it through its centre, and then, holding out his hand over and therefore parallel to the line, turn completely round without otherwise moving from his place, he will find that on completing a single full turn his arm will be once more over and parallel to the line on the table—his hand between himself and its centre—the relations of conjunction and parallelism in space having been gained simultaneously. But if now, starting from his regained original position, while making a turn on his own axis he will, at the same time, walk one quarter round the table, he will find that when his arm is again parallel to the line the centre of the table is at his side, and that he has to make another quarter turn to bring his hand between himself and that centre, when his arm is at right angles to the original line. Continuing his walk round the table to the other end of the line, while making another turn, he will now find that to bring his hand into conjunction he has to take a further quarter turn, and so on through the succeeding quarters back again to his point of departure. So that, by the simple act of walking round the table while revolving upon his axis, he has made five revolutions when counted from the wall of the room which he faced at starting, and but four when computed from the centre of the table.

A very simple analysis will enable the reader to form a just estimate of the teaching value of these relations. All that is necessary is that he should consider the walls of the room the zodiac, the centre of the table the sun, himself the earth, and his extended hand the meridian of observation, or the moon, when he will immediately perceive that, just as his own motion round the table causes his hand to resume its parallelism to the line before pointing again to its centre, so does the motion of the earth cause the rotating meridian, or revolving moon, to resume its parallelism in space, or regain its zodiacal star of departure, before returning into conjunction with the sun; and therefore that the angular distance traversed by his hand from parallelism to conjunction represents the difference between sidereal and solar time; and thus, by an inverse reading, he learns that this difference is caused by, and the measure in detail of, the orbital motion of the earth.

If now, while walking round the table, he will compare the relations of its centre to the walls of the room, he will see that it continuously passes between himself and the wall. This is an illustration of the third phenomenal evidence of the motion of the earth; for, regarding the centre of the table as the sun, the walls of the room as the zodiac or astronomical circle of comparison, and himself as the revolving earth, his motion round the table causes the artificial sun to pass in succession through all of the signs of the artificial zodiac, just as the sun actually does. In this way he is enabled to demonstrate that the annual passage of the sun through the signs of the zodiac is the reflection of the passage of the earth round itself.

The proper motion of the earth is thus learnt by the apparent motion of the sun, itself caused by an actual retreat of the zodiac round the advancing earth, such full retreat, or return of the sun to the same point in the same sign, being the measure of the full period of the revolution of the earth.

A simple but very important law flows from these relations: that every full revolution in space is measured by a full revolution of the circle of comparison.

Under this law, if the sun is revolving in an orbit within the zodiac, its motion ought to cause such another revolution; and so on, for any further bodies similarly revolving.

Two such revolutions are known—the recession of the lunar nodes and the precession of the terrestrial equinoxes. But in these the zodiac is advancing in space instead of retreating. This change in the direction of the apparent motion can, however, be accounted for. It depends upon the position of the sun being more concentric to the ultimate centre of intra-zodiacal motion than the systemic position of the earth; for, according to the well-known law, that when a body is moving the most remote of any two bodies on a line at right angles to its direction of motion appears to advance upon the intermediate body, since the earth here represents such an intermediate body it is necessary that, if the sun is moving, the zodia, should advance with it round the now retreating terrestrial systec.

The reason why the lunar node is the point through which the motion of the sun ought to be reflected, if it exist, is this—that it marks a definite position, in parallelism to space, of the terrestrial system, which may be considered relatively persistent, so that as the sun carries the terrestrial system with it along its extensive orbit, the node necessarily retreats round the zodiac. This phenomenon, also, the reader can, if so disposed, simulate experimentally. All that he need do is to hold a basin of water, with a cork floating near its margin, steadily in his hand, as he walks round the table, when—considering himself the sun, the basin of water the terrestrial system, and the cork the lunar node—he will now see that node retreat round the basin, just as the actual node recedes round the zodiac. And thus he will learn that the motion of the sun, did it exist, would cause just such a retreat of the lunar nodes as is recognised under observation.

* Henry Pratt, Esq., in *The Reader*.

DETONATING METEORS OF FEBRUARY AND NOVEMBER.*

By A. S. Herschel, B.A.

It is probably very seldom that a large meteor passes over the islands of Great Britain without some particular notice of the occurrence being made in one or other of the many public journals, which separately and collectively chronicle the passing events of every large town in the United Kingdom. It is, however, seldom that the accounts can be collected. It is yet more seldom that a regular channel is opened to the details that private persons are often well able to furnish, but which, from principles of sufficient or insufficient reason, they either deem it unnecessary to record, or think them better left to professional observers to supply. It is thus that a meteor of the largest size, on the 21st of November, 1865, shot directly over London, which was probably disregarded by many, who would ere now have consigned it to oblivion, if these few remarks should not have the good fortune to recall the fact of its occurrence to their memory.

Among the published accounts of the fireball of the 21st of November last was a description of the meteor by Mr. Warren De la Rue, as it appeared to him near Cranford. The attention drawn by so great a name as that of the late President of the Royal Astronomical Society to the circumstance, was the cause that several private accounts of the meteor were received by Mr. Warren De la Rue from observers in all parts, to whom prompt acknowledgments were returned for the interesting details which they describe. I have selected from the documents the following particulars. A comparison together of the accounts, at the same time, permits the real altitude, position, and velocity of the meteor to be determined, at least approximately, within small limits of error:—

The height of the meteor, at its first appearance is determined from six independent accounts, each of which was separately compared with Mr. Warren De la Rue's original observation of the meteor at Cranford for the point of first appearance. The average error of the separate accounts is seven British statute miles above or below the true mean height, which is the mean of all the separate heights, and is taken as the height at first appearance. The height at disappearance is determined in a similar manner, from the same six accounts, compared with the apparent place of disappearance of the meteor as observed at Wimbledon by Mr. F. C. Penrose. The average error in this case is, as in the former case, about seven miles above or below the true mean height at disappearance. When the nature of the phenomenon is considered, and particularly the difficulty of fixing the exact position of the apparent path of the meteor by the several observers, it is not surprising that occasional differences should exist in the resulting heights, but rather wonderful that such good observations could be made. The real altitude of the meteor at the moment of disappearance was somewhat greater than that of a detonating fireball (presently to be mentioned), on the 11th of February, 1850, investigated by Mr. Glaisher, which disappeared at a height of nineteen miles above Biggleswade, in Bedfordshire.

The meteor of the 21st of November, 1865, traversed the entire length of the valley of the Thames, a distance of about seventy-five miles, from about forty-one miles above the Nore to a point about twenty-seven miles above the earth's surface, in the neighbourhood of Henley-upon-Thames. On the average of four separate accounts, varying between four and ten seconds, the time taken by the meteor to travel the entire distance of about seventy-five miles was six seconds and a-half. On this estimate the velocity of the meteor relatively to the earth's surface was about eleven miles per second; and the direction of its flight appears to have been from a part of the heavens in the neighbourhood of the constellation *Taurus*, situated between *Taurus* and the head of *Cetus*.

The distance of the meteor at the moment of its disappearance from Wimbledon, as determined by the accounts, was about thirty-six miles. At Wimbledon Mr. Penrose heard a loud report, like that of a cannon fired off at the distance of some miles, distinct enough to be heard very plainly by more than one person at Wimbledon, about two minutes and twenty seconds after the meteor had disappeared. Sound, with its ordinary velocity of 1,090 feet per second in common air, would take two minutes and fifty-four seconds to travel the above distance, determined by the accounts, from the point of disappearance of the meteor to Wimbledon. Considering, as before, the difficulty of fixing the exact position of the apparent path of the meteor by the observers, and the very approximate nature of the real path concluded from their statements, the agreement of the calculated time with the time observed by Mr. Penrose between the disappearance of the meteor and the occurrence of the sound must be regarded as extremely close. There can be very little doubt, from Mr. Penrose's description, and from the near approach of the fireball to the earth (twenty-seven miles), as well as from its large size, and small velocity, that the meteor was in reality a fireball of the detonating class.

Detonating meteors are described in the *British Association Reports* as having been observed in England very nearly on the same date of the year as that of the 21st of November last. The first

* From the *Intellectual Observer*.

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xploded over Norwich, with a very loud report on the 19th of November, 1861; the second occurred on the 20th November, 1864. Of this the explosion was heard at Hallaton, in Rutlandshire, like the noise of distant artillery, lasting several seconds. Finally, a detonating meteor of unusual size, attended by a very violent report, described by Kepler, a description afterwards repeated by Halley in the *Philosophical Transactions* of the year 1719 (p. 978), which happened in Germany on the 17th of November, 1623 (N.S.), may be further thought, with a certain probability, or belong to the same zone of meteors encompassing the sun. As the length of the sidereal year exceeds that of the tropical year by just one day in seventy years, the date of Kepler's meteor (nearly two centuries and a-half ago) would coincide with the place of the earth in its orbit at the present time, on the 21st of November—exactly the date when Mr. Warren De la Rue's meteor was observed.

The apparent coincidence of dates in such rare phenomena as detonating fireballs is exemplified by at least one other remarkable instance, which deserves to be recorded. A brilliant detonating fireball was observed by Brydone on the 10th of February, 1772, as described by himself in the *Philosophical Transactions* for the following year. The meteor was followed by a startling report, at an interval of at least four minutes after it had disappeared An equally brilliant detonating meteor was seen from the Royal Observatory, Greenwich, by the present Astronomer Royal, Mr. Airy, on the 11th of February, 1850. It was ascertained by Mr. Glaisher that this meteor, to which allusion was already made above, as one of the best investigated examples, exploded at a height of nineteen miles above Biggleswade, in Bedfordshire. The report was heard in Oxfordshire, and in the neighbouring counties round, like a clap of thunder. Finally, an exceedingly large detonating meteor, of which full accounts appeared in the local papers at the time of its occurrence, appeared last year at Bangalore, in Southern India, with a report like a hundred cannons, on the evening of the 9th of February, 1865.

The 9—11th of February, and the 19—21st of November, are dates deserving future study, with the special view of determining the direction of the detonating meteors. At present the frequent return of detonating meteors on those dates plainly indicate the fact that these bodies, like the acknowledged star-showers of August and November, revolve in fixed orbits round the sun.

TRADE DISPUTES.

The Hull Engineers.—Last week the majority of the men employed at Messrs. Earle's shipbuilding yard resumed work, having accepted a compromise. Originally the men stood out for an advance of 3s. per week, which, in the case of some small firms having contracts on hand, was given, but the whole of the larger firms refused the application. The men seemed determined not to give way, and it was doubtful whether the advance of 2s. per week, offered by the masters, would have been accepted. However, a deputation from the Amalgamated Society of Engineers met the men on strike, and recommended them to acquiesce in the arrangement, and a resolution embodying this recommendation was adopted.

Serious Trade Dispute at Sheffield.—There s every probability of a disastrous strike and lock-out in the file trade in Sheffield. A number of the ifile-grinders are now on strike. Several stormy meetings have been held, and at one of them 4,000 men were present. The filesmiths have determined to support the grinders, who are backed up by the Association of Organised Trades of Sheffield. The masters say that if they were to grant the advances asked they would be unable to send files to America, where they are at present subjected to a sharp competition.

Strike of Masons.—On Monday morning the Durham masons turned out on strike for a rise of wages from 28s. to 30s. per week, and shorter hours of labour, and, three months hence, for a half holiday on Saturday. Other strikes are likely to take place in the building trades.

RECENT RESEARCHES ON METALS AND ALLOYS.*—I.

Iron.—As far as our present day's knowledge extends, no metal is more influenced than iron, either for good or for bad, by the presence in it of a minute quantity of another element; thus a few thousandths of carbon transform it into steel, and a few per cent. of the same element converts it into cast-iron; a few thousands of sulphur, or a few per cent. of silicium, renders iron "red-short"—that is to say, brittle at a red heat—whilst the same quantity (thousandths) of posphorus makes it "cold-short," or brittle at natural temperature. These facts explain why iron smelters and manufacturers do all in their power to use ores as free as possible from these impurities, or apply all their skill to remove them from the ores or metal when present. I am, therefore, satisfied that all iron smelters will appreciate the value of the following facts published by M. Caron in the *Comptes Rendus* of the Academy of Sciences of 1863, on the influence of manganese when used on the blast furnace to remove silicium from cast-iron. The following table shows the relative quantity of manganese and silicium existing in the cast-iron thus produced:—

	Manganese.	Silicium.
No. 1 . . .	7·93	0·05
„ 2 . . .	6·32	0·08
„ 3 . . .	4·70	0·30
„ 4 . . .	3·81	0·55
„ 5 . . .	2·25	0·76
„ 6 . . .	3·90	0·50 cold blast.
„ 7 . . .	2·10	0·75 hot blast.

This table shows that as the quantity of manganese decreases in the pig iron the quantity of silicium increases; further, that the higher the temperature (all the rest of the operation being conducted in the same manner), the quantity of silicium increases and the manganese decreases.

M. Caron has further made the important remark, that it is the interest of the iron-smelter to use as much lime in the blast furnace as practicable when manganiferous ores are employed, for not only does lime facilitate the introduction of manganese into the iron, but also helps in a marked degree to remove the excess of silicium.

Eight or nine years ago I made the observation that if manganese had not the property of removing phosphorus from iron, it had the one of hiding or of counteracting the bad influence of that element on iron; in fact, I found that cast-iron, containing as much as one or two per cent. of phosphorus, would yield good mercantile iron if the pig iron contained at the same time five or six per cent. of manganese, and I have lately heard that manganiferous ores have been used with great advantage by the Cleveland iron smelters to overcome the "cold shortness" of their cast-iron, which is due, as is well-known, to the presence of phosphorus compounds in the Cleveland iron ore.

It is highly probable that the advantages which have been derived from the employment of "spiegeleisen" iron, in improving the quality of steel produced by Bessemer's process, is owing, not only to the fact that this peculiar iron contains a large quantity of carbon, which it yields to the molten iron contained in the large crucible used in Bessemer's process, but that the manganese it contains contributes also to hide the influence of the phosphorus or to overcome the detrimental properties which a trace of phosphorus would impart to the steel produced by this process. I say hide, because the phosphorus is still present, since that substance cannot be removed by the above process from any pig iron in which it may be present.

M. Caron has published in the *Technologiste* for 1864, a paper in which he shows that no amount of lime on the blast will remove phosphorus from any ore which may contain it; and that tin-plate manufacturers and others who employ charcoal iron, should pay the greatest attention to the quantity of phosphorus contained in the charcoal they employ for refining ordinary iron; thus some charcoals are susceptible of yielding as much as 1 per cent. of phosphorus to iron, whilst others only 0·12 per cent., and lastly some only a trace.

If phosphorus, sulphur, and silicium are injurious to the quality of iron, the metal called tungsten, on the contrary, appears to improve in a marked degree its quality, especially when in the state of steel. This fact has not only been demonstrated beyond all doubt by Mr. Mushet, but also recently by some scientific researches due to M. Caron, who has proved that steel containing tungsten presents greater tenacity, and can be used with greater advantage for many purposes; in fact, he thinks that tungsten can be used instead of carbon as a converter of iron into steel. There can be no doubt that the employment of tungsten in connection with the hardening of steel, and other various applications which that metal is susceptible of, will be greatly enhanced if the fact stated in the *Chemical News* of August 25th is brought to bear, viz., that a Swedish chemist has found a simple and practical method of extracting tungsten from its ore so as to reduce its cost of production to a few shillings per pound.

Mr. R. Johnson and myself have published a paper in the Memoirs of the Royal Society, in which we showed that the conductibility of iron was greatly modified by the quantity of carbon it contained, as proved by the following table:—

	Found.	Conductibility of silver = 1000.
Wrought iron . .	13·92	436
Steel . . .	12·65	397
Cast iron . . .	11·45	359

We also found that the hardening of steel had the greatest influence on its expansibility, for whilst a steel bar, hardened to the maximum, expanded to a degree which may be represented by 84, the same steel rendered as soft as possibl y expanded only 62.

* Abstract of Lecture by Dr. F. Grace Calvert, F.R.S., F.C.S., being the 6th Cantor Lecture at the Society of Arts, May 16th, 1866.

REVIEWS.

Modern Marine Engineering. By N. P. Burgh. Part III. London: E. and F. N. Spon, Bucklersbury.

The third Part of this work, of which we have already spoken, contains one large coloured plate of details of supplementary inverted engine and surface condenser, for the steamer "Frankfort." In addition to the letter-press of the Part, there are abundant illustrative outline engravings, of double and single trunk engines, of single and double piston-rod engines, &c., which though roughly executed, yet serve their purpose. It is a pity that the printer does not display a little more of his art on the work in these days of tasteful printing. The want of skill is the more so apparent in consequence of the page being a most magnificent one for the full display of the power of a letter-press printer well up to his work. The flimsy letter-press does not alter the text of the work; but, when we turn from the brilliantly executed plates to the badly executed typography, the contrast is striking. We understand the book is quite a success. The coloured plates are worth the money charged for the entire part.

THE ADVANCE IN WAGES MOVEMENT.

It is easily observable that the determination expressed at the several preliminary meetings of working engineers in favour of a "rise" is one prevailing throughout the trade; also—and we would specially direct attention of the employers to this—that striking is deprecated, if it be possible to avoid it. The conviction is gaining ground among the men that a general conference between masters and men, or arbitration, is quite equal to the occasion, and this we sincerely hope it will be.

We regret to learn that the operatives employed in the various branches of the building trades at Woolwich and Plumstead have struck work for an advance of wages. Our impression was that all disputes in these trades had been settled. It is gratifying to hear, at the same time, that some large employers of labour in the district referred to have acceded to the requests of the men, and we hope that by the time these lines are read in Woolwich that the strike will be reckoned among the events of the past and harmony once more restored

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SUBMARINE TELEGRAPHY.

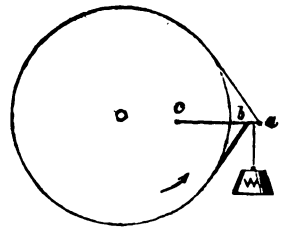
V.

LAYING AND REPAIRING CABLES.

The lecturer mentioned that he had received a letter from Messrs. Wells and Hall, stating that some lengths of their india-rubber cables had been at work for some time under water. This was not doubted, but did not affect the original statement, that much india-rubber had decayed, whereas no gutta percha under water had decayed. Mr. Hooper had also misunderstood the statement in the abstract that pure india-rubber yielded to continued pressure; this was not meant to apply to Mr. Hooper's material, which is always more or less vulcanized. Attention was also drawn to a map of the telegraph lines between Europe and the East, prepared by Messrs. Bright and Clark, and kindly lent by them. The following is an abstract of the lecture arranged under the heads of the syllabus:—

Stowage on board Ship.—The cable is coiled into large circular, or nearly circular, coils, so as to uncoil without receiving a twist, as shown on the last occasion. The coils are now held in iron water-tight tanks, and remain constantly under water. Tanks were first made for the Red Sea cable, but first used for the Malta-Alexandria cable. The tanks in the "Great Eastern" were three in number, from 51ft. 6in. to 58ft. 6in. diameter, and 20ft. 6in. deep. To prevent rolling, their centre of gravity should be only slightly below the water line. If the water be withdrawn from the tanks before the cable is paid out, the wires rust, and the chemical action heats them injuriously: with galvanized wires or cables covered with Bright and Clark's composition this heating does not occur. The eye of the coil round which the cable lies, generally from six to eight feet in diameter, is filled with a cylinder, to prevent the bight of the cable from falling down, and possibly forming a kink or loop. Mr. Newall uses a cone permanently fixed in the centre of the coil. Messrs. Glass and Elliott lower their solid eye as the uncoiling proceeds. The cone appears to the lecturer to afford the best guarantee against kinking. It was used in the Persian Gulf expedition. When running out at high speeds the cable, if unchecked, would fly out, urged by centrifugal force, so as to be dangerous and unmanageable. This tendency is controlled by rings, lowered as the tanks are emptied, and first forcing the cable to run horizontally towards the centre and then controlling its upward motion. These rings were first used by Messrs. Newall and Co.

2. *Break.*—From the tanks the cable is laid in troughs to the break, by which a restraining force is applied to prevent too rapid egress. The troughs in the "Great Eastern," from the fore-hold to the break, measured 450 feet. The cable is wound four or five times round a drum, six or eight feet in diameter, and the rotation of this drum is controlled by friction. The turns round the drum hold the cable securely, and prevent its egress unless the drum itself turns. The riding of the cable is prevented by a simple contrivance, known as the knife or plough, which was exhibited on a model. On the "Great Eastern" this knife or plough could be adjusted. The simplest manner of applying retarding friction to the break is to hang a weight on to a break strap, the other end of which is fixed. If the weight is hung from that end of the strap which would be lifted by the friction of the drum as it revolves, the retarding force can never exceed the weight, and a limit may be thus placed to the strain on the cable. But it was found in practice that with a strap making less than one turn round the drum, a weight of, say four tons, had to be applied to give a friction of one ton; the limit due to the position of the weight was, in such a case, of small value, since any heating of the strap or dirt on its surface might rapidly increase the strain fourfold. Mr. Appold's break remedies this defect. The principle on which it is constructed is illustrated by the annexed diagram. The end of the strap *a*, on which the greatest strain comes, is attached to a lever, hinged at *c*. Between the centre of the drum and *a*, the other end is attached to the lever very near *a*; but between *a* and *c* the retarding friction is obviously equal to the difference of the strains on the end *a* and *b* of the break



strap, and the weight *w* is almost exactly equal to that difference. This relation does not depend on the co-efficient of friction between the strap and the drum; if the friction increases, the weight *w* is raised a little, and the lever *a c*, owing to the eccentrical position of *c*, slightly lengthens the break strap, reducing the friction. The opposite effect occurs if the co-efficient of friction diminishes. The motion of *c a*, required to tighten or loosen the break strap, is almost infinitely small, so that the angles of the break strap and lever and the relations of the strains do not sensibly vary. This arrangement was used on the "Great Eastern." It worked admirably, and gives a perfect safeguard against the application of any unforeseen strain by the friction of the break strap. Strains may, however, occur from other causes, and for their detection a dynamometer is used between the break and the stern. The cable is passed under a weighted pulley, at a somewhat obtuse angle. The weight thus hanging on the cable is raised higher and higher as the strain on the cable increases. A scale is constructed by experiment showing the height corresponding to each strain. By this simple contrivance the actual strain on the cable can be observed at any moment. The following is a convenient formula for calculating the relation between the strains on break straps and the friction produced. Let Q be the strain on that end of the strap which holds back the wheel, P the strain on the other end, *f* co-efficient of friction, and *b* the angle embraced by the strap in circular measurement (unit=57·296°)

Then; $Q = e^{fb} P$, where $e = 2{\cdot}71828$.

f may be taken for leather on iron . . . . = 0·35
" " iron on iron, wet . . . . . = 0·15
" " wood on iron, wet, less than 0·1

3. *Theory of Submersion.*—In October, 1857, Professor William Thomson published in the *Engineer* a short sketch of the true mathematical theory of the form assumed by a cable while sinking, and the strains to which it is subjected under various conditions. The consequences of this theory were much more elaborately worked out (independently of Professor Thomson's publication, the lecturer believes) by Messrs. Brook and Longridge, in a paper read before the Institution of Civil Engineers, in the spring of 1858. Much of what follows is taken from that paper. If the ship and cable are both at rest in still water, the latter hangs in a catenary curve, the strains on which are known and easily computed. This case actually occurs whenever a ship stops paying out cable, for instance, to cut out a fault; if the cable were suddenly stopped so as to lie at a great angle with the vertical line, a strain would be produced so great as infallibly to break the cable; thus for a catenary in which the cable at the point of suspension lies at an angle of 9° 30′ with the horizon, the strain at the point of suspension is equal to 72½ times the weight of the cable hanging to the same depth vertically; so that in 2,000 fathoms the strain would be equal to the weight of 145 miles of cable; but the Atlantic cable would break as soon as the strain exceeded the weight of 11 miles. From this it will be seen that a cable cannot be immediately stopped whilst being payed out, but must be gradually checked while the ship is backed, so as to keep the cable where entering the water as nearly vertical as possible. Another conclusion which follows is, that the cable while being paid out cannot possibly be hanging in a catenary curve, since the Atlantic cable did lie at an angle of about 9° 30′, and the strain, instead of being 2,030 cwt., was only about 12 cwt. The following consideration may help us to perceive how different the case of a body sinking regularly is from the case of a chain at rest:—Suppose the ship to drop a number of spheres of the specific gravity of the cable into the water at regular intervals; each of these would, within about 2ft. of the surface, acquire a definite, sensibly constant velocity $v = \sqrt{\frac{w}{q}}$ where w = the weight, and q the resistance to the body moving at one foot per second; these spheres, moving with constant velocity at constant intervals of time, would lie in a straight line from the surface to the bottom, and would be more or less inclined to the horizon as the speed of the ship was less or greater. If the spheres were joined by an infinitely thin string, to which the water offered no resistance, they would form a cable which could be laid without any tension whatever, and with an amount of slack or waste depending simply on the inclination of the line to the horizon. The practical case of a submarine cable lies between these two extremes of the catenary and the isolated spheres; each short length of the cable lies like an inclined rod in the water, and has, therefore, a tendency to shoot back in a given direction, whereas the isolated spheres tend to fall vertically. Owing to this, cables, or, at least, heavy cables, cannot be laid without tension except at the expense of an enormous waste of cable. It will be unnecessary here to repeat the whole mathematical investigation which is given in Messrs. Brook and Longridge's paper. It will be sufficient to give the results arrived at.

* Lecture III.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, February 5.

MOTIVE POWER FROM AMMONIACAL GAS.—II.

(*Continued from page* 348.)

According to promise made last week, we will now proceed to describe the working of the machine, first of all giving a description of the apparatus for expelling air from the machine. Reference is made throughout to the illustrations in our last number.

To form a vacuum in the machine before introducing the liquids, a cock is fitted between the generators, which allows of a current of steam being sent directly thereinto; this steam returns to the cylinder, the piston is put in motion and drives the air and steam into the condenser K, which is then empty. As to the utility of the tubes before mentioned provided with a screw thread and cock—they are placed, one on the condenser K, two on the receiver I, two on the condenser K^1, two on the condenser K^2, one on the condenser K^3. An iron tube is applied to these so as to close them and put those of the condenser K in communication with those of the receiver I. Another tube passes from the second of these tubes on the receiver to the first of these tubes on the condenser K^1; a third tube from the second on the condenser K^1 to the first on the condenser K^2; and a fourth tube from the second on the condenser K^2 to that on the condenser K_3. These four tubes are only placed at the commencement of the operation to put the machine in work. A cock at the lower part of the condenser K_3 is then opened to put all the interior of the machine in communication with the exterior. The steam drawing the air goes from the generators to the cylinder, then to the first condenser, next through the other parts in succession, and finally issues by the cock of the fourth condenser. The pump working during this time likewise becomes void of air; then by imparting by hand or otherwise motion to the distributing axle all the air is driven from the pipes. As the ammoniacal gas cannot be poured out in contact with the atmosphere without danger, the safety valves pass it into an apparatus where it is dissolved in water. With

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this arrangement the water cannot rise again in the adducting tube, and the external air cannot re-enter because the valves are closed before the atmospheric pressure overcomes that of the generator.

Before putting the machine into action the air is driven out by sending through a current of steam from the boilers; the communication of the steam with the generators is then closed, and immediately afterwards the escape cock, then the cock of each of the tubes with a screw thread. The cooling of the apparatus evidently produces a vacuum therein. The liquids are introduced by means of a vessel closed by a cock on two sides. At bottom and below the cock the funnel neck terminates in a screw thread to fit exactly on the tubes of the apparatus. The lower cock being closed the vessel is filled with pure water up to the level of the funnel, that is to say, to the top of the cock which I next close; then the lower neck is screwed n the tube of the condenser K, and the cock of the gas is no longer condensed in the condenser K; second, it is dissolved in the condenser K^1; third, a communication is opened by the pipe C_1, box C, and pipe C^6 between the condenser K and generator d^1, into which all the liquid already hot and supersaturated flows from the condenser K; fourth, the receiver does not communicate with any condenser; fifth, by the pipe B^1, box B, and pipe B^2 communication is opened between the generator d and receiver I, into which the pressure of the gas causes all the liquid, in a great measure spent, to rise from the generator d. As the machine works the piston of the generator d^1, the surface of which is only about half that of the piston of the receiver I, overcomes the latter owing to the great differences in tensions, and the piston of the receiver is at the bottom of its course; it remains in this piston as long as the liquid is not entirely decanted; but when this is complete the gas arrives after the liquid, and equilibrium of tension is established between the interior of allow the piston to descend again and become ready to act. Next it is the condenser K, now empty, which receives the spent liquid from d^1; then also the pump produces a vacuum therein, and the atmospheric pressure will cause the piston to descend and become again ready to act as before. The water of the condensers is supposed to be entirely deprived of ammonia, but if an excess of ammonia is employed, so that the water of the condensers may contain a certain quantity before entering into service, the supersaturation is produced before the service of the generators is finished. The gas, as before stated, is dissolved in the condensers; and, when it is observed either from diminution of tension in the generator or from elevation of temperature of the liquid which it contains that this liquid is spent, the machine is stopped by hand or otherwise, an eighth turn is given to the distributing axle when the condensers have cooled. The condenser K is emptied into the generator d. Another eighth turn is given to

FIG.

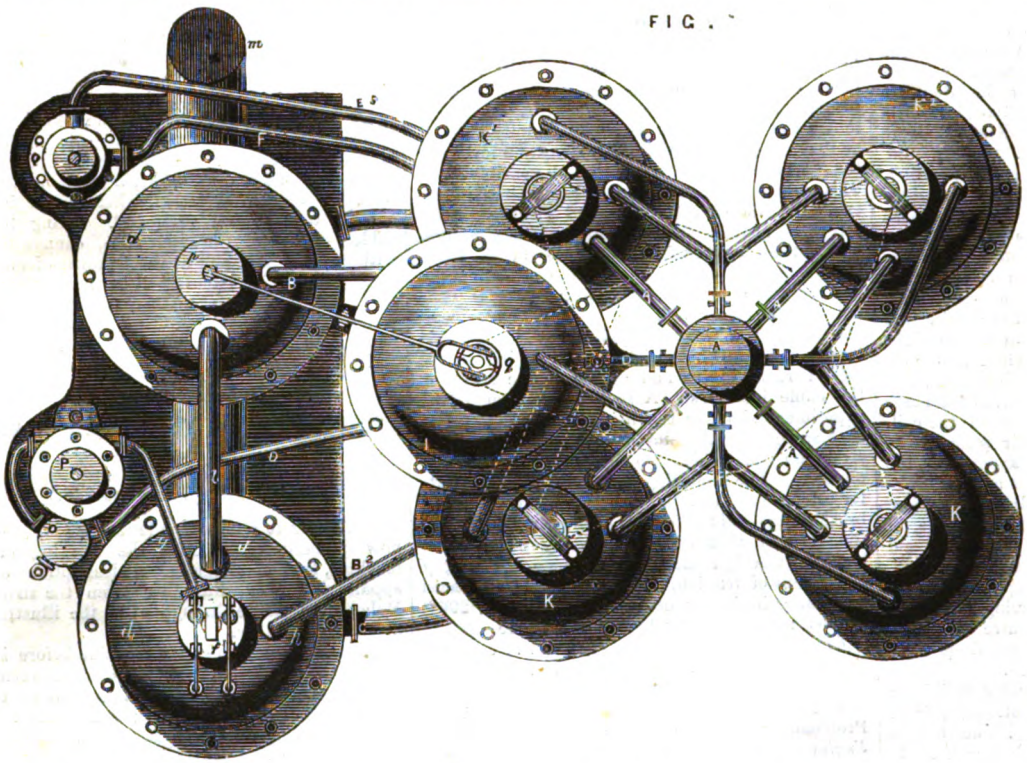
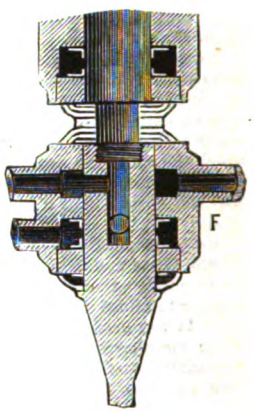


FIG. 3.



the tube and the lower cock of the vessel opened. The liquid flows in without introduction of air. In this manner there is introduced, in the following order, into the condenser K about 50 quarts of water.

,, ,, K_1	,,	50	,,	,,
,, ,, K^2	,,	40	,,	,,
		10	,,	ammonia at 21° Baumé.
,, generator d		10	,,	water.
		50	,,	ammonia at 21°

On starting the distributing boxes are arranged that, first, the gas issuing from the cylinder is redissolved in the condenser K; second, the suction pipe of the pump acts on the condenser K^2; third, the force pipes acts on the condenser K; fourth, the receiver is in communication with the condenser K^2. The liquid of the condenser K becomes heated because the gas has already an acquired temperature of from 120° to 212° Fahrenheit, and because in dissolving it produces an elevation in temperature. In time the gas coming from the cylinder and the condenser K is no longer capable of dissolving. The internal pressure will exceed the atmospheric pressure, and the piston on the receiver will rise; in rising it turns the screw and draws the small wheel, which, making a complete revolution, produces one-eighth of a revolution of the wheel M^1 on the distributing axle; this last, movement produces five different actions:—First the generators and that of the receiver: the piston of the receiver immediately overcomes this and rises. The openings of the box C are larger than those of the box B, in order that the liquid of the condenser, which is emptied, may pass entirely into the generator, which becomes filled before the second generator is emptied. The piston of the cylinder in rising produces another eight turn of the distributing axle, which causes the following actions:—First, closing of all communication between d^1 and K; second, closing of all communication between d and I; third, communication is opened between I and K^3, into which the liquid arising from the generator d finally flows; fourth, inversion of the relations of the pump, which now forms a vacuum in K^3, and forces the gas therefrom into K^1; fifth, the condenser K^1 is in relation with the cylinder. The machine continues to work as before. It will be seen that a great portion of the caloric absorbed during the first period is thus utilized. The condenser K^3, which contains a hot and still ammoniacal liquid, is cooled while the other condensers are in work; it is cooled the more because the pump in forming a vacuum therein draws the gas and a little steam, which greatly accelerates the lowering of the temperature. The receiver, which during the first period communicated with K^2, now communicates with K_3, and the pressure diminishes sufficiently rapidly to the distributing axle and the machine to work. The condensers K^1, K^2, become saturated, and the water added in the condenser K^3 stops the excess gas. When the liquid of the generators is spent the machine is stopped. The ammoniacal contents of only the three last condensers are preserved, and their density tested. They will be sufficiently charged to be used again in the machine. The absence of water accelerates the cooling of the condensers, but by admitting a current of cold water a rapid condensing machine is produced of great simplicity. There is neither receiver, condenser, nor pump; the machine is composed of an insulated steam generator, three gas generators, and a system of distribution composed of three boxes, one to distribute cold water, the second to distribute steam, and the third to direct the condensation of the gas. Each generator contains two pipes, one to receive the steam to heat the ammonia, and the other for the passage of a stream of cold water.

Generator No. 1	contains	ammonia at 21° Baume,		120 parts.
,, ,, 2	,,	water —	,,	60 ,,
		ammonia at 21°	,,	40 ,,
,, ,, 3	,,	water —	,,	60 ,,
		ammonia at 21°	,,	40 ,,

We are not aware that any machine on this principle has been erected in this country; if so, we shall be happy to hear the results—including cost.

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THE LATHE AND ITS USES.*

IX.

An indispensable article on a foot lathe, where any fancy work is to be done, is the centres—of which we have before spoken—shown in Fig. 40. These consist of a common set of heads, with spindles fitted to them. One spindle has an index plate and spring, and the other has a common

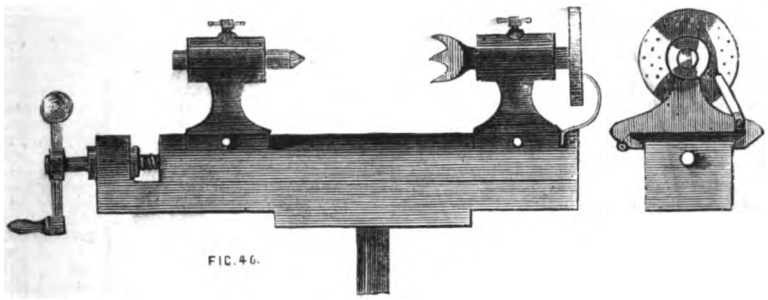


FIG. 46.

centre. These heads set on a slide that is moved back and forth over a rest, screwed to the lathe bed as usual. It is easy to see that with this we can do some very fine cabinet work. Suppose we have a round vase turned up handsomely, and we wish to flute the base or make it a series of curves all round; to do this we have only to put it in the centres, set the index so as to come out even, as before explained, and go ahead.

The kind of cutter to be used is a sort of gouge set in a cast-iron head, something as a plane iron is set in its stock—that is, fitted tight to a groove, and held by a set screw. Two of these cutters should be used at equal distances apart, and the cutter head should be keyed on a short shaft set between the main centres of the lathe. The whole should be accurately balanced, or else the work will be full of chatters or ridges. Since centrifugal force increases as the square of the velocity, anything that runs a little out of truth will be very much exaggerated as the speed increases. By using cutters of different shapes beautiful effects can be produced; as, for instance, suppose we take a common round-nose cutter; set the index so as to divide the circle of the job we are to work on in twenty-four parts, and execute that part of the design; then take a tool forming an ogee and work out the spaces intervening; we shall find that the article, when completed, will have a beautiful appearance, and that instead of being round the bottom will be octagonal, which will present a pleasing contrast to the rest.

The centres can be set at any angle with the cutter shaft, and a pine-apple pattern can be made on straight surfaces by executing one part at one angle, then reversing the rest that carries the centres, and finish the remainder, one part of the pattern crossing the other.

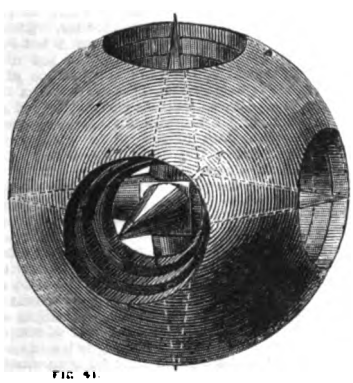
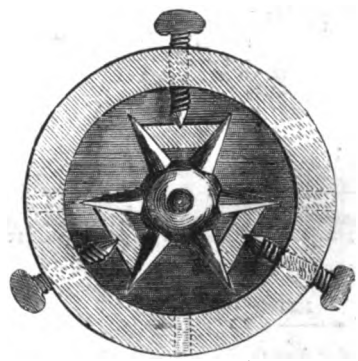


FIG. 41.

We present herewith views of a novel ornament which exhibits great mechanical ingenuity and manual dexterity, but is otherwise of no value. It consists, in one form, of a globe with a series of rings or globes inside, and a six-armed spur projecting through holes, all cut out of one solid piece.

This figure shows how the points are turned. After the internal rings are cut out with a quadrant tool like Fig. 43, and the spur also severed, by cutting in the ends of the holes (not boring them out solid), the globe is put in a shell chuck with three set screws in it, as shown. The set screws go through the holes in the globe, and the cross pieces in between the spurs serve to steady the job. Any number of points may be turned in the globe. Fig. 44 shows a polygon with many

FIG. 42



spurs turned inside. At first sight it would appear that the tool severing the rings would cut off the points also, but it will be seen that this is not the

FIG. 43.

case, for the holes being bored so as to leave a core standing (which afterward serves to make the points of the spur), the severing tool falls into the holes and goes no further, and each division serves as a guide for the tool in the next hole, so that the globe is made the same size, without jags. The quadrant tool, shown before, must be followed

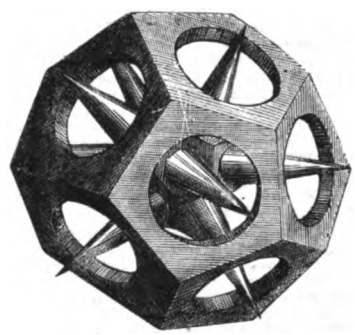


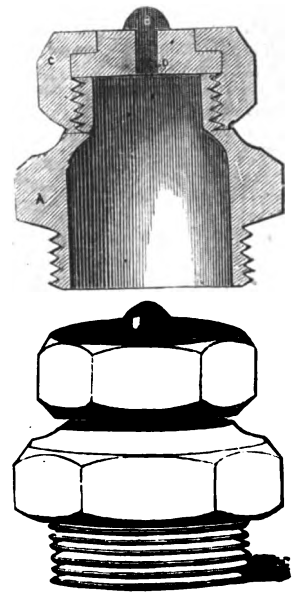
FIG. 44

round the shell in the act of cutting it out, so that it will make the same round, and the globe must be shifted in the chuck to reach all the holes. It is no easy task to make this little affair, for all it looks so simple.

* Mostly compiled from the American Journals.

BAILEY'S FUSIBLE PLUGS.

The accompanying engraving represents a fusible plug patented by Mr. Bailey and manufactured by Mr. W. Tate, Cooper-street, Manchester. Its construction is very simple. The fusible metal D



is traversed by a copper pin B, which transmits the heat equally through the metal, and tends to prevent that deterioration to which fusible metal in such formations is exceedingly liable. We believe that this plug answers very well, about 5,000 being in use.—*The Engineer.*

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

The ordinary monthly meeting of the members of this Society took place at their rooms in Doctors' Commons, City, on the 3rd instant. Mr. Joseph Newton, president, filled the chair on the occasion, and the attendance was numerous. The first part of the sitting was devoted to the reception of the minutes of the previous meeting, the election of many new members, ordinary and honorary, among the latter of whom were S. Worssam, Esq., of Chelsea, and John Timme, Esq., manager for Messrs. Maudslay, Sons, and Field; and a discussion upon the progress and prospects of the Institution. In the course of the latter it was suggested that the rapid growth of the Society rendered it necessary to think of obtaining a more commodious place for holding its meetings, a rather promising idea, and one which it is to be hoped may ripen into reality. If the Associated Foremen possessed a hall of their own, they would find that the repugnance of employers to share in their consultations would be dissipated. It is not the persons but the place to which the masters take exception. A tavern is hardly the fittest arena for scientific debate, however well adapted for meetings of a less intellectual character.

The paper read on this occasion was one written by Mr. J. M. Oubridge, on "The various modes of Iron Smelting." It was of great length and considerable practical interest. To some extent, however, it was historical—in fact, a summary of all that was yet known of the art upon which it treated. The reader's descriptions were rendered much more lucid by his facile production of diagrams on the black board, and his conclusions met general approval.

A brief discussion—the lateness of the hour preventing a lengthy one—followed, and in this Messrs. Keyte and Briggs and the Chairman took part. Finally a vote of thanks was accorded to Mr. Oubridge, and the members separated.

THE value of the mineral traffic on the Midland Railway in 1863 was £263,000; in 1865 it was £312,000.

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PHOTOGRAPHIC TEST.

WE learn from Vienna that Herr Wilhelm Viessig has produced an improvement in the means for ascertaining the presence of fixing agents in photography, and in removing these agents therefrom. To test whether hypo-sulphite of soda or other "fixer" has been removed by washing or otherwise, M. Viessig places the prints after they are washed, or the fluid in which they have been washed, in communication with the poles of a galvanic battery. By this means the fixing agent is decomposed, and sulphur—if hypo-sulphite of soda has been used—appears at the negative pole of the battery. But if silver be employed for this pole the effect produced will be more readily seen. Herr Viessig, as indicated, has a mechanical method of removing the fixing agents. The photographs are made to rotate, so as to throw off the liquid rapidly by centrifugal force. The apparatus is stated to be a folding frame, covered with lattice work, under which the photographs are placed, the framework tightened; the framework is then mounted on a spindle, and is made to revolve rapidly by means of a handle or treadle. The "test" just noticed is applied between successive washings and operations of the apparatus for driving off the moisture.

SCOURING STONES AND MARBLES.

WHETHER we are ever to attain to perfection in the subject of our heading we cannot say; that there is room for it there can be no doubt; and that efforts are being made to meet the requirement, the patent list published twice a week, gives ample evidence. Among others Messrs. Shipley and Walker, the former of Shipley, and the other of Idle, in Yorkshire, have made their endeavours to provide machinery which shall produce a smooth and even surface, and to avoid the grooves—the faults in the usual system of scouring. For this purpose, within a rectangular framework trams are placed to bear wheels or rollers which carry a moving table having a reciprocating motion within the framework. This table carries the blocks, and over it is placed a framework into which small slabs, lighter than those on the table, are secured by means of tightening screws through the side of the framework. This upper frame is connected to a crank on the driving shaft by means of a connecting rod, having ball joints near either end and at right angles to the connecting rod, which imparts the reciprocating motion to the bottom table. A second connecting rod is attached to the upper table at right angles to the first-named one, and this is actuated by an eccentric. The apparatus being set in motion the operation is as follows:—The lower table has simply a reciprocating motion, whilst the upper has a two-fold one, being moved both transversely and longitudinally by the connecting rods before named, thus obtaining a parabolical motion giving the results named. At least, so the patentees say: we have not seen the machinery, and therefore cannot vouch for the correctness of the statement.

PURIFICATION OF GAS-COAL.

An important essay upon the purification of coal-gas has been written by Professor Anderson, of Queen's College, Birmingham, and has been published for private circulation. It relates chiefly to the methods discovered by the author for the successful removal of bisulphide of carbon and the sulphuretted hydrocarbon by the employment of the sulphides of ammonium. By washing the gas with this compound a very large proportion (nearly 35 per cent.) of the sulphur impurities are removed, and the illuminating power of the gas so far from being diminished becomes actually increased. Professor Anderson records several carefully-conducted experiments, all of which prove the truth of the conclusions at which he has arrived. We believe we are correct in stating that his method is now in operation at the Taunton and other local gas-works, and that it is highly spoken of by those who have given it careful consideration. His pamphlet should be in the hands of all managers of gas-works; it is eminently practical guide to the purification of coal-gas.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

PITCH LINE OF WHEELS.

Sir,—Having observed a controversy going on between some of your correspondents with regard to the pitch line of wheels, I beg leave to send you formula for finding the diameter of the pitch line when the pitch and number of teeth is given, and also for finding the number of teeth when the pitch and diameter of the pitch line is given.

Let D = the diameter of the pitch circle.
,, P = the pitch in inches.
,, N = the number of teeth.

Then $N \times P$ = Circumference of Pitch circle = πD where $\pi = 3{\cdot}1416$, hence

$$N = \frac{\pi}{P} \times D \text{ and } D = \frac{P}{\pi} \times N.$$

For example, let the diameter of the pitch circle of a wheel with 40 teeth of ¾ in. pitch be required.

$$\text{then } D = \frac{P}{\pi} \times N$$

$$= D = \frac{\cdot75}{3{\cdot}1416} \times 40$$

$\therefore$ D = 9 548 inches

Or working it out—

```
3·14.6 )·75000 ( ·2387 × 40
         62832          40
        ------    -----------
        121680    9.548 inches.
         94248
        ------
        274320
        251328
        ------
        229920
        219912
```

Or suppose that the number of teeth is required, the pitch being ¾ in., and the diameter of the pitch circle 9·548,

$$\text{then } N = \frac{\pi}{P} \times D$$

$$= N = \frac{3{\cdot}1416}{\cdot75} \times 9{\cdot}5$$

$\therefore$ N = 40 teeth.

Or working it out—

```
·75)3·1416 (4 1888 × 9·548
    300
    ---
    141
     75
    ---
     660
     600
    ---
      660
      600
     ---
       600
       600
       ---
Then  4·1888
       9·548
      ------
       335104
      167552
     209440
    376992
   ----------
   39 9946624 teeth.
```

The result thus obtained is quite accurate enough for practical purposes, and I enclose you a table of the values of P and π from ¼ in. up to 6 in. pitch, which I have computed free from errors I hope. By means of this table the diameter of the pitch circle for any number of teeth can be easily found when the pitch is given, or *vice versa*. This will be best illustrated by an example. Suppose that the diameter of a wheel of 36 teeth, and 1¼ inch pitch was wanted at the pitch line, then looking in the table for the value $\frac{\pi}{P}$ we find it to be ·3978, and multiplying ·3978 by 36 we get the diameter of the pitch circle = 14·3208 in.

Your correspondent, J. Sharpe, finds fault with the arithmetic of Mr. Stanley and C. A. T., but I presume he is dealing with the outer circumference while they deal with the pitch circle; if I am mistaken will J. Sharpe be kind enough to let me know how he gets his result from Euclid? Multiplying the tabular value by the number of teeth gives 11·457 as the diameter of the pitch circle and 35 9933112 as its circumference. The proportions of the tooth and space are generally derived from the division of the pitch into 15 equal parts:

The whole depth of the tooth = 12 parts
The working ,, ,, = 11 ,,
The width of the space = 8 ,,
,, ,, tooth = 7 ,,
Depth from pitch line to root = 6½ ,,
,, ,, ,, point = 5½ ,,

TABULAR VALUES OF $\frac{\pi}{P}$ & $\frac{P}{\pi}$

Pitch.	$\frac{\pi}{P}$	$\frac{P}{\pi}$
¼ in.	12·5664	·0795
⅜ in.	8·4045	·1193
½ in.	6·2832	·1591
⅝ in.	5·266	·1989
¾ in.	4·1888	·2387
⅞ in.	3·5904	·24668
1 in.	3·1416	·3183
1⅛ in.	2·7925	·3577
1¼ in.	2·5133	·3978
1⅜ in.	2·2848	·4376
1½ in.	2·0944	·4774
1⅝ in.	1·9333	·51406
1¾ in.	1·7952	·55704
1⅞ in.	1·67605	·5968
2 in.	1·5708	·63661
2¼ in.	1·3518	·71301
2½ in.	1·2584	·7957
2¾ in.	1·1424	·8753
3 in.	1·0472	·9549
3½ in.	·8976	1·1108
4 in.	·7854	1·2732
4½ in.	·6981	1·4642
5 in.	·6283	1·5883
5½ in.	·571	1·7507
6 in.	·5236	1·9095
	Multiply the tabular value of the pitch in this column by the diameter for the number of teeth in the wheel.	Multiply the tabular value of the pitch in this column by the number of teeth for the diameter of the pitch circle.

J. D.

PRACTICAL PHOTOGRAPHY.

Sir,—In the ENGLISH MECHANIC for March 2nd, page 338, col. 1, the article "Practical Photography," written by "Plodder" in defence of his assertions in previous numbers, requires from me a reply.

I am perfectly aware that Plodder mentions his using the nitrate of silver bath with the addition of 4 or 6 drops of nitric acid to 6ozs. of bath for all purposes, and to which I again reply "will be all very well for positives, but a ruination to the obtaining of brilliant negatives," but in my proper negative bath, I can obtain the most brilliant positives, with a slight alteration in the ordinary iron developer. If Plodder means diluted nitric acid, containing 1 part nit. acid to 10 parts of distilled water, then the addition he mentions may answer. On page 248, col. 3, Plodder says "after some days' usage the bath will have a peculiar smell of ether and iodine,"—does he not mean ether and alcohol?—and goes on mentioning the cleansing process.

Properly speaking, cleansing a bath means filtering, but I suppose Plodder means strengthening. Had his instructions been written for advanced students in photography, I should never have taken him to task respecting the doctoring of a bath before it was really requisite; but when any subject is treated for the use of amateurs, it should be handled with freedom, and everything explained in the most distinct language, but anyone reading the above quotation would consider that a bath after some days' use (how many?) must be cleansed.

Again he says "I do not say that this plan is by any means accurate." But why does he not state that which is accurate? Upon reference to the work mentioned by Plodder, I find Chapter 4th devoted to the printing process, but referring to the instructions in the same work for the preparation of the positive and negative baths, there is no mention made of the addition of a strong solution of iodide of potassium, but recommends that after the solution of nitrate of silver is filtered, as large a plate as the bath will admit is to be collodionised and immersed in the bath for 3 or 4 hours, when the solution will be sufficiently iodized. This plan I have adopted for many years, and is preferable to the method mentioned by Plodder. What I stated respecting the carrying of a plate on a hot July day is perfectly correct, and, although I am not disposed to disclose my method of keeping the surface of prepared plates moist for a long time I can tell him that if he will leave the plate a little longer in the bath than is usual, take out and drain well on blotting paper, taking care to wipe the back of the plate perfectly dry, and after putting it into the dark slide, take two or three thicknesses of clean thick white blotting paper—a little smaller than the plate—and when just saturated with distilled water, place it on the back of the prepared plate, close the back, and wrap it in several folds of cloth—if slightly damp all the better—when it is ready to be run with to its destination; and should the bath, collodion, and developer be in good working order, the plate will be entirely free from any stains or marks, after the elapse of half an hour from the time of its removal from the bath, the negatives not having any signs of crape lines,—which depends upon the collodion, and the dexterity employed in collodionising the plate—or iron deposit.

I infer from Plodder's paper that he is an amateur, but if he had studied practical photography for fourteen years daily, as I have done, he would have been better prepared for his paper on "Practical Photography." AN OLD HAND.

BRONZING LIQUID.

Sir,—I send you an improved method of bronzing which may perhaps be of service to some of your readers.

The method consists of a fluid bronze composition, formed by combining metallic power, known by the names of gilding and bronze powder, with collodion, which composition is capable of being applied as a bronze liquid to

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urfaces of wood, iron, or any solid material, for the urpose of coating the same for decoration or preservation.
GEORGE DUTTON.

SYMPATHETIC INK.

Sir,—In some experiments the other day I discovered a ready method of making a good sympathetic ink which may perhaps be a source of amusement to some of your readers. To a solution of sulphate of copper, add a filtered (or strained) solution of chloride of lime, mix well, and filter or strain. A letter written with this ink will appear as if unwritten upon till held before the fire.
WM. PICKARD.

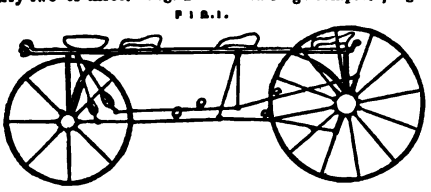
ROSEWOOD STAIN.

Sir,—Seeing several enquiries made from time to time for stains or dyes for wood, I herewith send you one for the benefit of your readers, who may perhaps turn it to some of their requirements, viz.—Liquid rose pink, to be used in imitating rosewood, &c., prepared as follows:—Take ½lb. of potash and dissolve it in 1 gallon of water, and add a ¼lb. red sanders wood thereto. When the colour of the wood is extracted, 2½lb. of gum shellac are added, and dissolved therein over a quick fire; the mixture is then ready to be used on a ground work made with logwood stain. I shall be glad to hear the result of its use from whoever may try it.
GEORGE DUTTON.

THE VELOCIPEDE.

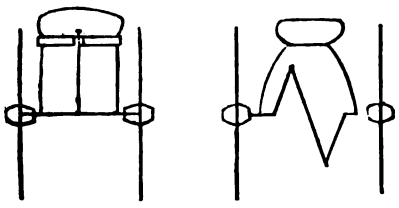
Sir,—Having seen several diagrams of velocipedes in your valuable paper, but not having seen one to carry three persons I send a drawing of one that will either carry two or three. Fig. 1 is the carriage complete, fig.

FIG. 1.



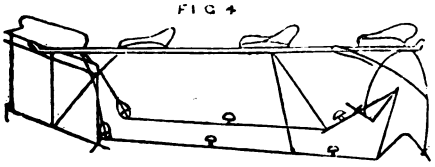
is the back view, fig. 3 is the front, showing the bow with

FIG 3 FIG 2



Which I steer it very easy, fig. 4 shows how the treadles are

FIG 4



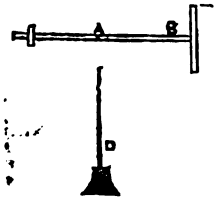
hung with a point in the middle. Two or three persons can propel this velocipede at the rate of 10 or 12 miles an hour with ease. Two of us have run 19 miles in 1 hour 45 minutes with but slight exertion. W. P. (Wheelwright).

THE CARBON QUESTION.

Sir,—Since 1861 I have known Mr. Tonkes, as a gentleman ready to assist the most simple enquirer, or take part in far advanced electrical problems, and in the past twelve months he has received the thanks, time after time, of the readers of the E. M. for information given at much trouble to himself. I know from his writings some years since that he must be well acquainted with carbons of almost every description, and needs no correction from anyone. I trust Mr. Tonkes will continue to give to amateurs that assistance he has long done, and in his own explicit way,
ELECTRA.

THE MAGNETIC NEEDLE.

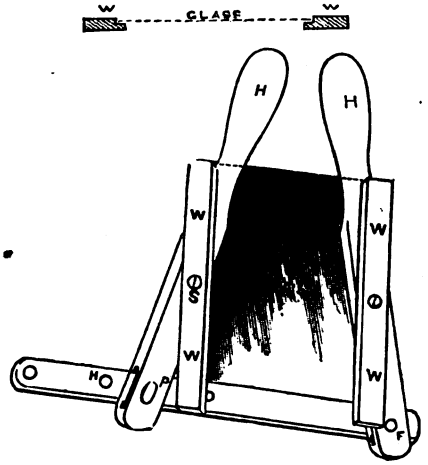
Sir,—Having seen in your valuable publication many interesting questions and answers on electricity, galvanism, and magnetism, I venture to give the result of some of my experience on the action of electric currents on the magnetic needle. First, I constructed a galvanometer, differing from that generally used, and in which the needle is free to move on its centre. My galvanometer was constructed as follows:—A light bar, B, of crinoline steel one foot long, working, at its centre, A, upon the point of a steel needle, 6 inches long. The steel needle is fastened in a small brass cone, the magnetic needle is fastened at one end of the steel bar, and at right angles to it, sometimes by its centre and sometimes by one end, so the needle cannot move on its own centre, only on the centre of the bar. The first experiments were made with



the wire conducting the electric current above or below the magnet and at right angles to it, which gives some very curious results. When the wire is above the needle or magnet the centre of the magnet runs away from the wire that conducts the current till the wire is at the end; but if you put the wire under one end of the needle it immediately places itself so that its centre is over the centre of the wire. I have made a great many experiments with my galvanometer, the principal object of which has been to prove the correctness of a theory of mine, regarding the manner that electricity passes along conducting wires, and to arrive at some better knowledge of the manner which electric currents pass in and around magnets. I think that electric currents pass spirally around conducting wires. This, though it may look a little complicated, will explain all the experiments of electric currents, and is no more far-fetched than saying that it is the influence of the magnetic current, always supposed to be present with the electric current. I deny the existence of magnetic currents as distinct from electric currents. JESSY LATHE.

PHOTOGRAPHER'S PLATE HOLDER.

Sir,—Allow me to forward you a very rough sketch of a very useful plate holder I made for holding the plates while being cleaned. I know there are machines for the purpose, but I think my one is quite new, and I know it is very effective. In those I have seen the glass was fixed in with screws, which took some time in turning and unturning, whereas the one I submit is the work of an instant, besides, the advantage of more accurately fitting the edges of the glass and thereby lessening the chance of breaking. It can also be used as a holder for exhibiting a portrait before dry. It is easily made, and I think that your amateur photographers (as myself) will find it of great service.



H, H, handles.
S, S, screws allowing the wood W. W. to form themselves parallel by the pressure of the glass edges.
H, H, holes in the lathe.
P, pin.
F, fixed pin. A. R. MOLISON.

OUR SUBSCRIBERS' NOTES AND QUERIES.

NEEDLE TELEGRAPH.—Can any reader give me a full description of the single needle telegraph instrument, also informing me of what material the different parts should be constructed? A description of the key of a Morse instrument would also greatly oblige.—ELECTRICITY.

LIGHTING ROOM, &c.—My room is lighted with five Argand gas burners, and I wish to light the same with electricity, to have as good or better light. Would an electric magnetic machine do? If so, where can I purchase one with lantern complete, or who makes them? Can anyone give me the size and cost of permanent magnet, horse-shoe magnet, size and length (B W G) wire?—A BRICK.

ELECTRO-MAGNETIC ENGINE.—Will "Electra," or any correspondent, give a description of an electro-magnetic engine suitable for working a small lathe? Perhaps this would supply a deficiency wanted by other correspondents beside myself.—POSTULATA.

RAKING FUNNEL.—Can any reader tell me how to rake a funnel or chimney of a steam boat, say the funnel is fifteen feet high and five feet diameter? I want to give it a rake of 2 feet 6 inches out of the perpendicular.—DANIEL LAMBERT.

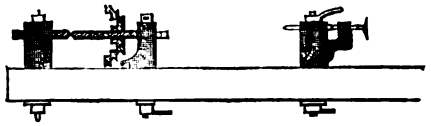
GILDING ON GLASS.—Can any reader tell me how gilding on glass is done, what sort of size is used to give it the burnished appearance seen on fan lights, names over shops, &c.?—W. S.

GEARING.—Will any reader be kind enough to let me know the highest speed that spur and bevel gearing can be driven with safety?—IPSO FACTO.

MODEL FIGURES.—Will any correspondent inform me where I can get some small figures about one inch and a half high, representing sailors in different positions, such as rowing, &c.?—MORPHEUS.

HARMONIUM.—I am about to construct an harmonium, but being only a novice, should like to know the cost of the reeds for 4 complete octaves, or the price per octave; also where I can purchase the ivory or bone for the keys, and any other information.—GEO. HAWES.

THE LATHE.—I shall be glad of some fellow-reader's advice on the subject of foot lathes for amateurs. I have an old one which has a deal frame, iron bed and headstocks, iron pulley and large double bevil foot wheel of iron, &c. It will be observed that the headstocks is in two parts, and that there is no means of screwing up the lathe mandril at the back of the head stocks. The mandrel is not



a traversing one as you will see, nor of hardened steel. I do not like the lathe as it is, nor can I cut screws in it mechanically. What would your practical readers advise me to do? Are the V-shaped beds as good as square shaped? For an amateur is a traversing mandril the best way of cutting screws?—WILLIAM STATHAM.

CHEMICAL WELDING OR SOLDERING.—Will any reader be kind enough to give me a receipt for welding iron or iron and steel together chemically?—GEORGE ATTWOOD.

NEEDLE MAKING.—Will any reader inform me how the long grooves in sewing machine needles are made, and what the cost of tools suitable for such purpose would be?—ALFRED CORFIELD.

LUBRICATING GREASE.—Can any reader tell me how to make a substance called hot neck and transparent grease used as in lubricating?—AN ENGINEER?

GROUND FLINT.—Will some reader inform me where I can get ground flint such as potters use in the manufacture of china ware, with price per cwt.?—A CHEMIST.

DEVONSHIRE, OR SHINING ORE.—Can any correspondent tell me where I can get the Devonshire or shining ore in a powdered state, with price per cwt.?—A METAL WORKER.

OXIDE OF IRON PAINT.—Can any reader explain the full process of manufacturing minimum or oxide of iron paint for all kinds of iron work?—GEORGE DUTTON.

STEAM PRESSURE.—Will any subscriber inform me at what pressure I have been working a small boiler at, the size of the valve being ⅜, and the weight on the top of the valve 6½ lbs.?—R. W. B.

BOOKBINDING.—Can any reader inform me where I can get books bound by Hancock's patent process, and what would be the cost of binding an 8vo. book in cloth by this process, which consists in binding with a solution of india-rubber in naphtha, thus doing away with the stitching?—FRANK W. GRIERSON.

OUR SUBSCRIBERS' EXCHANGE.

PRACTICAL PHOTOGRAPHY.—If Plodder will forward his name and address, I will, during the coming season, send him examples from plates kept long in a moist state.—AN OLD HAND.

COLOURING GOLD.—I shall consider it a favour of any correspondent will inform me of the process of giving to articles of jewellery that peculiar dead colour usually passing under the name of coloured gold. I should be happy to remunerate any one fairly for the knowledge, if the process is a secret, he does not wish to disclose publicly.—RICH. JONES, Llanidloes.

BOILER.—Can any reader inform me where I can purchase a boiler suitable for a one horse engine, cheap.—RICHARD BROWN, Carhill.

CETERATAS (No. 48) is requested to communicate with Thomas Beard, 7, Swanscombe Street, Canning Town, E.

SLIDE LATHE.—I have a small working model of a self-acting slide lathe, which I would exchange for a working model of locomotive engine with fixed cylinder. I have also a small horizontal engine with oscillating cylinder and boiler, which I would also give if this locomotive is a very good one.—JAMES WILSON, Brixworth, near Northamptor.

NEW COPY OF CAMPIN'S HANDBOOK OF TURNING, 7s. 6d.—The owner wishes to lend it for another good work on the same subject, or will make a permanent exchange.—Care of ED. E. M.—W. H. N.

VERTICAL TUBULAR COPPER BOILER.—W. G. P., 6, Elyplace, Dublin, will be glad to strike a bargain with any one possessing a boiler of the character and dimensions described in "Answers to Correspondents," under the heading 'W. G. P., (Dublin,)' in the ENGLISH MECHANIC of March 2, 1866; or any person making such will oblige by forwarding price to the above address.

VELOCIPEDE.—I have 4 wheels, a crank, brass bearings, and body of a single velocipede, which I am willing to exchange for a small steam engine or boiler large enough to drive a full sized lathe. I am willing to pay the difference.—W. POATE, Havant, Hants.

REPLIES TO QUERIES.

SLATE DISTEMPER FOR PHOTOGRAPHIC BACKGROUND.—J. Watson.—Take whiting, 1½ to 2lbs.; lampblack, 3oz.; damp blue, 4oz.; glue, 1½oz. Dissolve the whiting in two quarts of water, add nearly all the blue, then add the black, gradually (trying after each addition by dipping in it a piece of paper and drying at the fire), till you get the exact colour required. Then having dissolved the glue in warm water, pour it in, to keep the colour from falling off, mix thoroughly together, and strain through canvas.—J. A. H. (Wolverhampton).

SODA WATER may make an excellent cement for his purpose, as follows:—Soak isinglass in water till quite soft, then dissolve it in the smallest possible quantity of proof spirit, with the aid of a gentle heat. In an ounce of this

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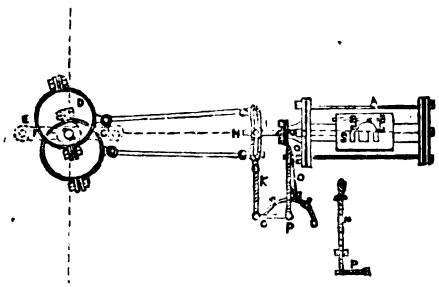
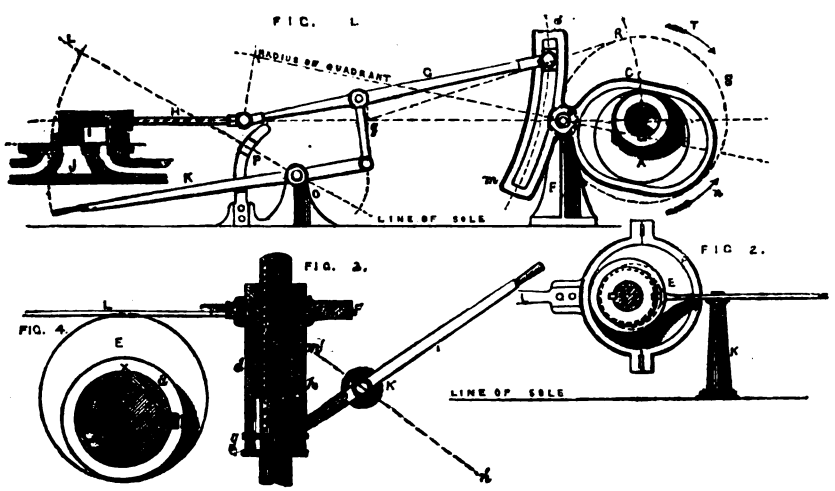
dissolve five grains of clear gum ammoniac, and while the mixture is still warm, add fifteen grains of clear gum mastic dissolved in one and a half fluid drachms of spirits of wine. If the fractures are quite clean, and the cement is used while still warm, the result will be everything Soda Water can desire.—W. Pickard.

Reversing Motion.—Exchange wishes to know a simple way of constructing a mechanism to reverse the motion of a small horizontal steam engine, also the mode of setting the slide valve. Enclosed is a plain drawing of a reversing motion. A is cylinder, B slide valve shown on its side,



C C steam ports. D D eccentrics, E F E G cramp on centre, H valve rod end, I cross head which works in link J, K is a rod betwixt link and lever M, N is lever guide, O a spring with catch L in groove U. To set the valve, let the crank be at E F, with the valve open at S C, about a 64th part of an inch, with eccentrics a little over centres, as position on drawing so as to have a little lead; turn the crank to E G; the valve must then be a 64th part of an inch open. To start the engine, move lever M and press the spring O to liberate catch U, and put the lever right or left whichever way you want the engine to work.—E. J. W.

Reversing Motion.—At the request of Exchange I send sketch of two reversing motions, which I hope he may find suitable for his purpose. Fig. 1 represents a reversing motion with a single eccentric pulley A, keyed on to the crank shaft B, working a strap and quadrant c, d, which oscillates on the pin e, supported by the bracket F, and fixed to the sole plate or anywhere most convenient. The quadrant in moving to and fro, works the eccentric and valve rod g, and h, (it will be seen that the valve J, and the steam ports J, are shown here in a "side" position, but this is done so as to make it more easily comprehended,)



according to position of crank shaft and quadrant, the back instead of sides of valve and ports should be seen; K is the reversing handle (working on a pin in the bracket O, which same bracket holds the guide P, with slots for handle) which on being moved up to L, throws the eccentric rod g, to bottom of quadrant at m, and reverses the engine in the direction of the arrow n; the engine with the valve as set on sketch is at half stroke; q is centre of piston rod head, and R, centre of crank pin; the dotted circle S, is path of crank Steam is, according to position of valve, entering at the back of piston and the engine is consequently revolving in the direction of the arrow T. Figs. 2, 3, 4, represent another kind of reversing motion which is pretty simple; a, is the crank shaft with a "scroll" or groove b, cut on it, this groove resembles a common screw, with a very slow spiral, and only extending half way round the shaft, as is shown at b, c; over the shaft is placed a "thimble" d, bored out exact; and through this "thimble" there is put a small pin x, which fits into the scroll or groove on the shaft; over the thimble is placed the common eccentric pulley and strap e, and f; there are two collars g, and a key or feather h, on the thimble, the collars for working the thimble backward and forward by the reversing handle I, and the key or feather for dragging with it the eccentric pulley and strap; K is standard for carrying reversing handle; L, is the eccentric rod. The motion is simply as follows:—When the engine is wanted to be reversed, the handle M, is thrown in the direction of dotted lines m1, n1, which throws the thimble on end (the eccentric does not move longitudinally, as the key runs slack in it), and the pin x, instead of being at top of shaft as is shown in Figs 2, 4, will now be shifted to bottom, and because the key h, is attached to the "thimble," and into the key bed in eccentric pulley, it will thereby also turn it to the bottom of shaft and reverse the engine. Both modes are simple, as only one eccentric is required.—John Agriculturist.

"Soda Water" may try something like the following, which is used for fixing metal letters to glass windows:—Copal varnish, 15 parts; drying oil, 5; turpentine, 3; spirits of turpentine, 2; liquified glue, 5; to be melted together, and mixed with 10 pints of slaked lime.—Geo. Hardey.

J. C. S.—Skeleton Leaves.—Soak the leaves for some time in dilut d sulphuric acid, which will gradually soften and remove the fleshy part of the leaves. The remaining fibres may afterwards be bleached by a weak solution of chloride of lime.—Geo. Hardey.

Strain of Timber.—W. E H. will find the transverse strain of timber supported at each end and loaded in the middle, from the following rule:—If the beam be Memel take 1731 as a constant and multiply it by four times its depth in inches and by its area of section in inches, and divide by the length of bearing in inches. The quotient will be the greatest weight the beam will bear in lbs. Thus

$$\frac{1731 \times 10 \times 4 \times 10 \times 5}{300} = 11540$$

The fourth part of this is the safe load, $\frac{11540}{4} = 2885$ The following are a few constants of timber used for building purposes:—Memel, 1731; Christiania, 1562; pitch pine, 1632; red do., 1341; Riga fir, 1103.—R. B. Hilton.

Skeletons of Leaves.—J. C. S. may procure skeletons of leaves provided he is sufficiently careful by steeping them in a solution of chloride of lime, which will destroy all but the "ribs."—W. Pickard.

T. W.—Copal Varnish.—See "Dr. Ure's Dictionary of Arts." The copal is melted and mixed with hot linseed oil, well stirred, allowed to cool a little and mixed with warm oil of turpentine. The proportions vary, say, copal, 7 lbs, linseed oil, 4 pints; oil of turpentine, 3 gallons.—Geo. Hardey.

Copal Varnish.—J. W.—For copal varnish I have met with the following recipe, which is, I believe, an excellent one, but unless J. W. wants a large quantity he will find it much the best to purchase it ready made. Copal in coarse powder, 5 lbs.; clean sand, 5 lbs., mix and enclose in a linen bag. Dissolve ½ lb. of camphor in 50 lbs. of methylated spirit, put it into a cohobation apparatus, suspend the bag near the surface of the liquid, and boil till the copal is dissolved. J. W. must not attempt to do without the apparatus as it will not only be useless but dangerous. Copal is not soluble by ordinary methods.—W. Pickard.

Cooling Fluids.—Slide Rule may cool water by immersing the vessel which contains it in another containing sal-ammoniac, 5 parts; saltpetre, 5 parts; water, 16 parts; this mixture will be about 16° Fahr., and by adding Glauber salts, 8 parts, the temperature will fall to zero or nearly so.—W. Pickard.

Incrustation of Steam Boilers.—J. H. L—The water supplied to my boiler deposits about a bushel of chalk as dust in 24 days' working, and also deposits a hard scale in the boiler, very difficult to remove. I put 28 lbs. of common washing soda in the boiler, four or five days before it is cleaned out (once a month), and the scale is quite soft and easily removed, requiring not one-tenth the labour to chip it off that was necessary before I used the soda. I used to put the soda in when I filled the boiler, but I think it softens the scale better by being only boiled four or five days at the least. A friend of mine puts two bushels of rye bran in his boiler with good results; wheat bran is of no use. To prevent priming.—Put a small quantity of tallow in almost every day, as my boiler is too small to work without priming.—R. R. S.

Book of Reference.—"Moulder" is informed that he can procure a work entitled "Overman's Moulder's and Founder's Guide" of Spon, Bucklersbury, price 5s.—P.

E. Watley.—Do not despair, all will be right when condenser is fixed; try, and if you fail, send it to me through "Our Subscriber's Exchange." I will gladly test it gratis.—Electra.

House Telegraphy.—B. P. Ellis has been instructed by G. Cuzner how to construct a domestic telegraph, but I cannot see that any alphabet is mentioned, nor batteries and sending key. For the benefit of Mr. Ellis and all readers, I must state that telegraphs for short distances are of little use, and from room to room, a perfect nuisance. I am acquainted with nearly every instrument used in England and abroad, including toy instruments, imported from Germany; but the most simple will cost at least £6 the pair. I name a few systems, and will explain any you wish, Morse, printing inst., by signs; Bright's—Bell's, read by sound; Baine's—signs, on prepared paper; Cook's—single and double needle, read at sight from a vibrating needle; Du Jardine's—Roman type printer; Caselli's, pantelegraph; Wheatstone's, magnets instruments; Siemen's magnets instruments, and many others.—Electra.

Specula, Telescope Stand, Rain Gauge.—Thanks.—I beg to return my sincere thanks to the various gentlemen who so promptly and kindly gave me such excellent information in reply to my enquiry on Specula. I also sincerely thank A Fellow of the Royal Astronomical Society, for his kind reply to my enquiry on Telescope Stand, as it is all I could desire. Thanks to Long to Rain over us for his kind information respecting the rain gauge, and for his final remarks, for I shall take the hint and profit by them.—Asteo.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

All letters intended for the Editor should be addressed to 75, Fleet-street.

Letters applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the Editor cannot undertake to return such as may be rejected.

J. A. H. (Wolverhampton).—The views are good and effective, but you will scarcely find a market for them in London, where the trade is overstocked and subjects of a mere local value generally a drag.

A Young Beginner.—We are informed that Mr. Coleman's patent is still protected, so that you will be liable to an action.

W. Clarke (Manningtree).—See Anion's communication in Replies to Queries, No. 48, also many others in back numbers.

Robert Williams.—In our opinion a very small sum, say five shillings per month, will amply remunerate your landlord for the amount of waste steam you require.

Charles.—Let the tent legs and camera stand be of bamboo; there is nothing better.

S. C.—We do not know of such a work, but if you write to Messrs. Spon, booksellers, Bucklersbury, they will send you a list of works on the subject.

R. R. Smith.—Thanks for your good wishes; we shall be glad to hear from you occasionally.

C. Clifford.—Received.

Geo. Hawes.—The writing is good, you will improve with practice.

Richard Fisher.—Thanks for the trouble you have taken. The letter unfortunately arrived too late for use.

Robert Hull.—We could not answer earlier. Try all we can, many letters must remain in arrear.

G. Monroe.—The white marks on ladies' muslin dresses are produced in this way:—The calico printer's pattern block is wetted with a solution of citric acid which is transferred to the muslin to be treated. The colour is thus discharged, and the white pattern produced.

S. T.—Your communication reads too much like a free advertisement. We always have it in our power to refer our correspondents to tradesmen, but we have found that they prefer as a general rule the information kindly proferred by our practical readers.

J. K. K. is thanked, but the question has been ably answered by "Long to Rain over Us."

Zoology.—The ways are so numerous and depend so much upon taste that we cannot spare space for the necessary instructions; some very excellent articles on the subject have appeared in the pages of the "Intellectual Observer," published by Groombridge and Sons, 5, Paternoster-row, and also in the "Popular Science Review," and "Science Gossip," published by Robert Hardwicke, 192, Piccadilly.

Hathaway.—The cost will depend much upon the size and finish. Plenty are to be had in Birmingham. Why not advertise for one?

John Baston.—The information has appeared in our columns more than once.

A. Hind.—We think that the common spring will answer your purpose well enough and save expense.

W. G. P.—We meant "speculate a few shillings—in advertising." We do not think your old sized boiler is "in stock" anywhere, unless among amateurs. We have therefore inserted your wants in our "Exchange" list, in another column Failing that, send a rough sketch to a brazier, with instructions to get it up in best Scotch plate. Braziers make them at so much per pound large sizes: yours would have to be by agreement.

F. J.—We have mislaid the address and also the number of the specification, but will endeavour to obtain the information for you.

Charles Thomas.—Of Messrs. Trubner and Co, 60, Paternoster-row, London, E.C.

Man of Kent.—We can give you no further information but if you write to Mr. Woodcroft, at the Office of the Commissioners of Patents, Southampton-buildings, Chancery-lane, you will learn all that you require. Enclose a stamped envelope for reply.

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N. THOMAS.—To obtain silica pure, fuse sand with four times its weight of carbonate of lime in a crucible. When cool, the mass is broken up, and muriatic acid is to be added to it; the silicate falls downs in a jelly-like shape. Dried and washed a white gritty powder is obtained—pure silica.

JOHNSTON. Steam is most generally used; you will most likely obtain such a work from Spon and Co., booksellers, Bucklersbury.

JOHN JARDINE.—The idea is a very good one, but we should not advise you to risk a patent.

J. WEBSTER.—We have not kept diagrams, but if you write to Mr. Forbes, he will doubtless oblige you with other copies.

TODMOR.—Will shortly appear.

R. THOMAS—Yes. Write to Mr. Weale, bookseller, High Holborn.

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

PATENT RECORD.

lected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

William Peter Le Keux, gas engineer, 32, Seymour-street, New-town, Deptford, improvements in detonating and light signals for railways and other uses.

598. Henry Wilson, Victoria Works, Belvedere-road, Lambeth, improvements in sawing machinery.
601. Jabez Henry Forshaw, Barrow-in-Furness, Lancaster, improvements in revolving shutters.
603. Hugh Robertson, Motherwell, Lanark, improvements in the manufacture of oil and other products from bituminous substances, and in the machinery or apparatus employed therein; which improvements or parts thereof are also applicable to the manufacture of white lead or other pigments.
604. Frederick Morton Eden, King's Bench Walk, Temple, an improved apparatus for holding and driving cutting and other tools.
618. George Cowdery, Crawley, Surrey, improvements in machinery for making bricks.
627. Walter Weldon, Park Villa, West-hill, Highgate, a new process for obtaining soda from common salt.
634. William Conisbee, Herbert's-buildings, Waterloo-road, improvements in machinery for grinding and equalizing the thickness of lithographic stones.
646. George Prentice, and Alexander Binny Inglis, Glasgow, improvements in the annealing of metallic plates, and in the apparatus or means employed therefor.
652. Edward Edwards Colley, and Walter Moss, Fleet-street, an improved self-acting card distributor.
654. Nathan Thompson, 16, Abbey-gardens, St. John's-wood, improvements in tools for dividing wood into cylinders.
660. Jacob Hort Player, Birmingham, an improvement or improvements in the manufacture of phosphorus.

LIST OF SPECIFICATIONS, &c.

PUBLISHED DURING THE WEEK ENDING MARCH 3, 1866.

780. Engines and carriages for common roads, &c., A. R. Mackenzie—10d.
781. Gasometers, tanks, &c., C. H. Pennycook—4d.
782. Lubricating spindles and shafts, J. W. Midgley—4d.
783. Vessels of war and ordnance, W. V. Greene—4d.
784. Boots and shoes, D. Gourlay—4d.
785. Machinery for manufacturing nails, pins, and rivets, —C. Farmer, and T. Turner—1s.
786. Looking glasses, mirrors, &c, J. H. Johnson—8d.
787. Registering compasses, W. Arthur—1s. 4d.
788. Preparing hydrated oxide of chromium, R. A. Brooman—4d.
789. Cutting pasteboard, &c., W. Clark—2s. 8d.
790. Fire-arms, R. J. Gatling—1s. 4d.
791. Valves for hydraulic engines, J. Smith, and S. A. Chease—1s. 6d.
792. Cutting bread, W. Berry—8d.
793. Thrashing and rubbing barley, &c., B. J. Webber—10d.
794. Dressing felloes, H. S. Jacobs—1s. 2d.
795. Punching sheet metal blanks, G. Farmer—4d.
796. Distilling coal and peat, W. M. William—10d.
797. Treating waste bleaching liquors, H. Potter—4d.
798. Propelling vehicles, W. Lane—4d.
799. Clarifying beer, W. J. Coleman—4d.
800. Fire-arms and cartridges, A. P. Tronchon—10d.
801. Manufacture of fabrics in lace machinery, W. Clark —6d.
802. Obtaining motive power, V. Baker—4d.
803. Jewellery cases, &c., J. J. Carter—4d.
804. Dyeing and printing fabrics or yarns, A. Paraf—4d.
805. Preparing china clay, &c., J. Wright—8d.
806. Manufacture of iron and steel, M. Morgans—4d.
807. Engraving on metal, R. A. Brooman—4d.
808. Washing wool hair, &c., G. E Donisthorpe—10d.
809. Argand gas burners, W. M Baker—6d.
810. Weaving ornamental fabrics, J. Macaulay, and R. Watson 4d
811. Toast racks, J. Burley, and L. Glover—4d.
812. Feeding paper to printing machines, E. Field, and F. Wise—4d.
813. Ventilating cornices, &c., T. H. Sanders—6d.
814. Stoppers for bottles, &c., C. H. Crowe—4d.
815. Reading designs for weaving, D. Mackenzie—6s. 4d.
816. Travelling bags, L. A. Leins—8d.
817. Treating fats for candles, R. A. Brooman—4d.
818. Compressed air engine, Baron Von Rathen—7s. 2d.
819. Sewing and stitching, R. W. Morrell—1s. 10d.
820. Worsted carding machinery, H. Oakes—8d.
821. Manufacture of cloth, &c., J. Lees, and M. Mellor—3s.
822. Constructing walls, &c, J. Tall—10d.
823. Weighing grain, &c, T. Robert—1s.
824. Looms, G. H., and J. A. Castree—10d.
825. Paying out and raising electric cables, R. Tidman—4d.
826. Stoves ash pans, and fenders, J. C. Morgan—8d.
827. Obtaining motive power, M. P. W. Boulton—10d.
828. Dredgers, W. Simons, and A. Brown—1d.
829. Cabin furniture, C. Bevan—4d.
830. Sewing machines, A. Baillot—4d.
831. Ornamenting japanned goods, &c, T. Farmer, and F. Lewis—4d.
832. Rails for railways, W. Loeder—1s. 2d.
833. Umbrella and parasol tip fasteners, R. Lublinski—4d.
834. Casks for petroleum, &c., J. B. Brown—4d.
835. Cutting screw threads, J. Green—10d.
836. Ink, W. E. Newton—4d.
837. Washing, wringing, and mangling, J. A. Swanzy—4d.
838. Gun locks, D. Arnold—8d.
839. Signalling in railway trains, J. C. Stovin—4d.
840. Obtaining motive power, V. Baker—4d.
841. Apparatus for obtaintng light, G. F. Marchisio—10d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of THE ENGLISH MECHANIC.

PROPERTY RECORD.

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SALES AT THE GUILDHALL COFFEE HOUSE.

By Messrs. DEBENHAM, TEWSON, and FARMER.

Lease for about 18 years, of those premises being No. 16, Old Change, and also premises adjoining—sold for £1,200.

Leasehold premises, being No. 45, Cheapside, and No. 2, Bread-street, term 21 years from 1857, at £1,128 5s. 10d. per annum—£2,700.

Leasehold house, being No. 15, West-square, St. George's-road, Southwark, term 15½ years unexpired, at £10 10s. per annum—£250.

AT GARRAWAY'S.

By Mr. W. MOXON.

Leasehold residence, being No. 21, Prospect-place, Wandsworth-road, with coach-house and stable, term 37 years unexpired, at £6 15s. per annum—£450.

Leasehold two residences, being Nos. 1 and 2, Taymouth-villas, Amhurst-road, Hackney-downs, producing £142 per annum, term 92 years unexpired, at £16 10s. per annum—£1,780.

AT THE EASTERN HALL, LIMEHOUSE.

By Mr. J. G. PREVOST.

Two leasehold houses, Carter-street, Poplar, producing £42, lease 52 years, ground-rent £5—£320.

Two six-roomed dwelling-houses, Nos. 16 and 17, Watney-street, Commercial-road, lease 31 years, ground-rent £16 per annum—£300.

Two leasehold houses, Nos. 9 and 10, Marmaduke-street, Cannon-street-road, lease 23 years, ground-rent £4 4s. per annum—£190.

MEETINGS FOR THE WEEK.

TUESDAY.—Civil Engineers, 8. Discussion upon "The hydraulic lift graving dock." Photographic, 8. Ethnological, 8. 1. Sir John Lubbock, Bart, and Mr. Frederick Lubbock, "On the true assignation of the Bronze Weapons, &c." 2 Rev F. W. Farrar, "On the Adaptation of Races of Man." Royal Int, 3 Professor Frankland, "On the non-metallic elements."

WEDNESDAY.—Society of Arts, 8. Mr. A. M. Bell, "On Visible Speech; or, a Universal and Self-interpreting Physiological Alphabet." Graphic, 8. Microscopical, 8.

CHEMICAL NOTES.

SUBSTITUTE FOR PHARAOH'S SERPENTS.—"Serpent's Eggs," being made by sulpho-cyanide of mercury, an article which is difficult to make and a hard matter to obtain in country towns, or even cities, I would suggest a cheap and simple mode of making an article which forms an excellent substitute:—Take 1 part of flour sulphur, 6 parts of cyanide of mercury; rub the sulphur in a mortar with the cyanide of mercury to a very fine powder (the finer the better), then make a cone of tin foil and pack the powder into it rather loosely, leaving sufficient room at its bottom to close it. If tin foil is not convenient, moisten the powder and form a cone of the same, as pastilles are formed, place in the sun or near a fire until sufficiently dry.—*Correspondent of Scientific American.*

PREPARATION OF ALUMINA FOR COLOURS.—Dullo obtains pure alumina in a very fine state of division by dissolving one kilog. of alum in five litres of water, adding five grammes of sulphate of copper. He then throws into the solution about 250 grammes of zinc cuttings, and places the whole in a properly heated place for two days. The copper is first precipitated on the zinc, and a voltaic battery is formed. By continued action the zinc is dissolved, and the alumina is gradually deposited. The reaction is ended when the solution gives no precipitate with excess of ammonia. If the action is prolonged, oxide of iron may be thrown down, which will give the alumina a yellow colour. Should this happen, the iron may be removed by boiling a few moments with very dilute sulphuric acid.—*Deutsche Illust. Gew. Zeit. and Bull. de la Soc. Chim.*, Jan., 1865, p. 78.

AN AMMONIACAL DEPOSIT FORMED BY DRYING BLOOD.—In the Journal of the Chemical Society Mr. J. A. R. Newlands describes a curious deposit which he found upon the roof of a shed in which blood was being boiled and dried. It was composed of silica, peroxide of iron, and sulphate of calcium in small proportions, but nearly ninety-seven per cent, of it consisted of sulphate of ammonia.

SCIENTIFIC NOTES.

MR. JOHN BROWNING has communicated to the Royal Astronomical Society an account of a new method of mounting the silvered glass specula and diagonal mirrors in reflecting telescopes (the invention of M. Foucault), which are receiving more and more attention, in consequence of their cheapness and portability.

AT a recent meeting of the Academy of Sciences at Paris, M. Becquerel communicated a memoir on the zones of hailstorms in the department of the Seine and Marne, based on the meteorological reports of several societies. It is very remarkable that in some spots (e.g., the forest of Orleans) hailstorms should have been so very rare, while other places have suffered much and frequently from them. M. Becquerel acknowledges ignorance of the causes of this difference, but considers that they are terrestrial and atmospheric. At the same meeting a memoir, by M. Peuzole, was read on an important subject—the composition of the soda extracted from sea salt by Leblanc's process. In a note by M. Splitberger on the colouration of glass, read at the same time, he says, in regard to the diathermancy of coloured glass, that he has not found any difference between black and yellow glass. White glass lets more radiant heat pass through, in the proportion of four to six. He discovered a striking analogy between yellow glass and heated sulphur in regard to the spectrum: When the glass was coloured reddish brown it extinguished all the more refracted rays of the spectrum—the red ray alone remained visible. Smoked glass, on the contrary, let more yellow than red rays pass. A letter from M. Giraud was also read, in relation to a memoir by M. Dulaunay on the acceleration of the moon's motion, in which he refers to a remark in Professor Tyndall's work on heat, on the influence of the moon on the tides, and the consequent diminution of the velocity of the earth's rotation.

ELECTRICITY APPLIED TO SOUNDING.—In deep sea sounding, the greatest difficulty is felt, even by experienced persons, in ascertaining the precise moment at which the lead of the sounding line touches the bottom, a matter on which the whole value of the sounding depends. An apparatus, invented by M. Hélouin, of Lyons, removes every uncertainty on the point. The sounding line he employs contains within it, along its whole length, two insulated conducting wires, the upper ends of which are connected respectively with the poles of a galvanic battery in the ship. The lead is in two parts, the lower one of which is partially inserted into the upper, and is capable of a limited vertical motion within it; so that, when left to hang freely, a small empty space is left within the upper portion, by the spontaneous descent, for a short distance, of the lower portion. To the upper end of the lower portion, and within the upper portion, is attached a commutator, which is contained in an insulating and waterproof sheath, and which, when the lower portion of the weight is raised by contact with the ground, comes in contact with the ends of the conducting wires, so as to complete the circuit. Instantly, by means of the ordinary electro-magnetic apparatus, a bell is rung on board the ship, to attract the attention of the sounder, and a ratchet is thrown into action, which arrests the unwinding of the line from the drum on which it is coiled, so that no more can run out. This apparatus is applicable also, when the lead is kept hanging down at a certain distance from the ship, of indicating the presence of rocks or reefs, or that the water has become shallow, so as to give timely notice of approaching danger.

ART NOTES.

KENSINGTON and Brompton will be in a bustle at the beginning of April, when the National Portrait Exhibition will be opened; and this bustle will scarcely have subsided when it will be renewed by the International Horticultural Show; to say nothing of a possible Royal ceremony in connection with the Central Hall of Arts and Sciences, proposed to be erected on the plot of land, belonging to the Exhibition Commissioners, between the conservatory in the Royal Horticultural Gardens and the Kensington High-road, and nearly opposite to the Prince Consort Memorial, now in slow progress. For the purchase of stalls and boxes in the Hall, the sum of £47,300 has been already subscribed, the price for a box in the first tier in perpetuity being £1,000, payable by instalments; for one in the second tier, £500; and for a stall in the amphitheatre, £100. The hall—which is to be available for, amongst other purposes connected with science and art, congresses (both national and international), performances of music, *conversazione*, and exhibitions of works of art and industry—consists, according to the published plan, of an arena, an amphitheatre, and two tiers of boxes, with a spacious corridor above these, affording room for the exhibition of pictures and sculpture. The building is an oval in plan, about 270ft. one way and 215ft. the other; is to accommodate 5,600 persons; and is estimated to cost £200,000, exclusive of the value of the land, which will be granted by the Commissioners for 999 years, at a merely nominal rent. The Commissioners will also guarantee a considerable part of the money required for the building, provided the public subscribe the remainder needed, say £150 000, by May, 1867. If we understand rightly, the design adopted by the promoters of the undertaking was made by the late Captain Fowke.—*Builder*

MESSRS. LUCAS AND GROOM, Wigmore-street, published some capital photographs from pictures by various artists, and of different classes—so as to suit, no doubt, several orders of taste in art. Best among them is a copy from Mr. Armitage's "Esther's Banquet," recently exhibited at the Royal Academy—a capital rendering of the subject. We have also two subjects of wrecks, by Mr. E. Duncan; a humorous subject, by Mr. Dever, styled "Please have you seen Mother?"—a little girl's question in the street; and others of inferior value.

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PHOTOGRAPHIC NOTES.

Transferring Collodio-chloride Prints to Paper.—These pictures, printed on glass or on mica, are exceedingly beautiful when transferred to paper. It is well to wax the glass, as recommended by Mr. Burgess, before coating. Mr. Frew has described a good plan. Paper is prepared with a gelatine solution similar to that for the Eburneum process, and dried. When wanted it is placed in clean cold water for a second, and laid on the glass plate, after the picture has been toned, fixed, and well washed. This is best done by letting one edge come in contact with the glass, and then lay it down so that the water may flow away, leaving the paper in contact with the collodion film. Now place two thicknesses of blotting paper over it, and run a paper knife over the whole, using a gentle pressure, when all air bubbles will disappear. It should next be placed in a warm room to dry, and in an hour or two it will be ready to be stripped from the glass. Another method is described by M

On Intensifying Negatives.—After fixing and washing, pour some of the iron developer over the plate, and let it remain one or two minutes; then wash the plate evenly but not quite thoroughly, after which apply sulphide of potassium 1 ounce to a pint of water. Pour back into the bottle and examine by holding to the light, and repeat *ad libitum*. If this will not answer, wash off the sulphide, as directed for the iron, and apply the developer the second time, and repeat with the sulphide until the lights are as opaque and black as desired. As a rule, I should say that a fully exposed negative which is lacking in vigour may be strengthened in this way better than in any other, and that an under-exposed negative, or one with just the right exposure, may be strengthened best with the pyrogallic re-developer.

GLEANINGS FROM SCIENTIFIC WORKS.

M. Herapath found that certain hieroglyphics traced on a linen bandage taken from a mummy were written by a solution of silver resembling marking ink. The silver was believed, on good authority, to have been dissolved in nitric acid.

It has been ascertained that wax under a pressure of 13,000 lb. on the square inch requires thirty degrees additional heat to melt it, about one-fifth of the whole temperature at which it melts under the pressure of the atmosphere.

Fusel oil, an offensive product derived from the distillation of spirits, when distilled with sulphuric acid and acetate of potash, gives the oil of pears. Oil of apples is made from fusel oil by distillation with sulphuric acid and bichromate of potash.

An American telegraphist is led to the conclusion that on some occasions the "auroral energy" is equal to more than thirty-two million horse power for each cubic mile of space.

A lens, evidently intended for optical purposes, and not as an ornament, was found at Nineveh. It was plano-convex in shape, and about one 3-5th in. diameter. It was made from a crystal of quartz.

If a person were able to count at the rate of 200 in a minute, and to work without intermission twelve hours in the day, he would take to count a billion 6,944,444 days, or 19,025 years 319 days.

The great Polgooth mine in Cornwall has been worked for tin, with but short intermissions, since the time of the Phœnicians. The mine has not been sunk one single fathom during the last sixty years.

It is stated that waves seem to increase in height most nearly in the ratio of the square root of their distance from the windward shore.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

The supply of timber, iron, steel, tools, rails, casting, and other plant, as they may be required, for the War Department works in the Portland district, from 1st April, 1866, to 31st of March, 1867.

The Directors of the Swaffham Waterworks Company, Limited, are prepared to receive tenders for the construction of the following works, in sections as numbered in the undermentioned specifications:—1. Tower. 2. Well. 3 Engine and Boiler. 4. Three-throw Pumps. 5. Cast-iron Tank. 6. Cast-iron Pipes. 7. Laying Pipes, and subject to the general conditions numbered 3. Particulars of Messrs. Atkinson and Sons, 6, Quality-court, Chancery-lane.

Erection of a gymnasium in New-street, Cambridge. Particulars of Messrs. Sumpter, Hyde and Crane, 8, Free School-lane, Cambridge.

Supply of wrought and cast-iron and other metal work for the reconstruction of the Waterloo-bridge over the river Irwell. Particulars at the office of the City Surveyor at the Town Hall, Manchester. Also works in excavating, and the supply of stone, brick, and labour.

Supplying and fixing the Ouse Valley Railway, in Sussex, about 70,000 lineal yards of post and four rail railway fencing. Particulars of Mr. John Pickering, 14, Chatham-place, Blackfriars, London.

Completing the spire of the church at Wheatley, a station on the Great Western Railway. Particulars of the Rev. E. Eston, Wheatley, near Oxford.

Erection of a police station, magistrate's room and offices, at Wellingborough, in the county of Northampton. Particulars at the office of the county Surveyor, Northampton.

Construction of a bridge and viaduct for the corporation of the borough of Stockport. Particulars of Mr. Brierley, Civil Engineer, Blackburn.

TENDERS SENT IN FOR BUILDING WORKS.

For first portion of Buckhurst Hill Congregational Schools. Mr. J. W. Morris, architect:—Abraham (accepted). £916.

Alterations to house, No. 30, Bridge-street, Sunderland. Mr. J. Tillman, architect:—Stafford and Baker (accepted). £160.

For the erection of two detached residences, for the Bedford Building Company. Mr. Usher, architect:—Winn and Foster, £1,620.

For alterations to No. 15, Stockbridge-terrace, Pimlico, for Mr. L. Hart:—Wigmore (accepted), £262 10s.

For alterations to No. 8, Upper Wimpole-street. Mr. W. A. Baker, architect:—Warne and Son (accepted), £1,477 6s.

For villa residence and stables, at Shepherd's Bush. Mr. W. A. Baker, architect:—Oughton (accepted), £2,441

For organ factory, in New Inn-yard, Tottenham-court road. Mr. W. A. Baker, architect:—Oughton (accepted) £2,725.

For works at the Riding School, Seymour-place, Bryanstone-square. Messrs. Bird and Walters, architects:—Williams (accepted), £1,529.

For house, Sunningdale, Berks. Mr. Bartleet, architect:—Conder (accepted), £2,887.

For Congregational chapel, Bromley, Middlesex. Mr. J. W. Morris, architect:—Abrahams (accepted), £2,830.

PRICES CURRENT OF TIMBER.

Per load—	£ s.	£ s.	Per load—	£ s.	£ s.
Teak	11 10	12 10	Canada, 2nd qual.	12 10	14 0
Quebec, red pn.	3 5	4 15	St. Petersburg yel.	10 10	12 0
yellow pine	2 15	3 10	Finland	8 0	10 0
Memel	0 0	0 0	Memel	0 0	0 0
elm	3 10	5 0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18 0	23 0
Dantzic oak	3 10	6 0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0 14	0 0
fir	2 5	3 10	Staves, per standard M.		
Memel fir	3 0	3 10	Quebec, pipe	80 0	85 0
Riga	3 5	3 10	puncheon	20 0	25 0
Swedish	2 0	2 10	Baltic crown pipe	170 0	190 0
Masts, Quebec, rd. pine	6 10	8 10			
yellow pine	5 0	6 0			
red pine	0 0	0 0			
Lathwood, Dantfm	5 10	6 10			
St. Peter's	7 0	8 0			
Yellow Pine, per reduced C.					
Canada, 1st qual.	17 0	19 10			

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OILS, &c.			Cocoanut, Coch. ton	51 10	52 0
Seal, pale pr. tun	50 0	0 0	Palm, fine	41 10	42 0
Sperm body	120 0	0 0	Linseed	39 10	0 0
Cod	50 0	0 0	Rapeseed, Eng. pale	49 10	50 0
Whale, 8th Sea pale	48 0	50 0	Cotton, seed	32 10	39 0

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Welsh Bars, in London	do	7 15 0	8 0 0
Wales	do	6 15 0	7 0 0
Staffordshire	do	8 15 0	0 0 0
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Hoops, first quality	do	9 15 0	—
Lead.			
Pig, Foreign	per ton	20 0 0	20 5 0
Red or minium	do	22 0 0	—
Quicksilver	per bottle	7 15 0	8 0 0
Steel.			
Swedish faggot	per ton	0 0 0	—
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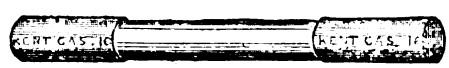

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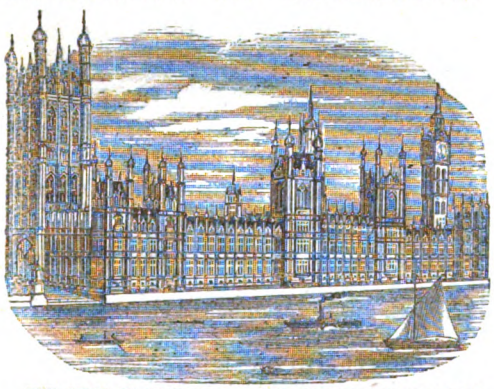

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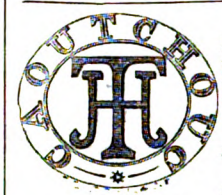

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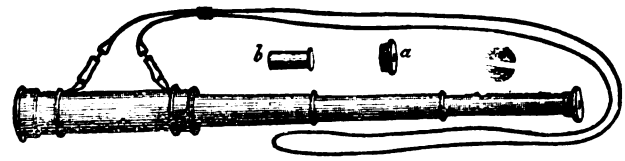

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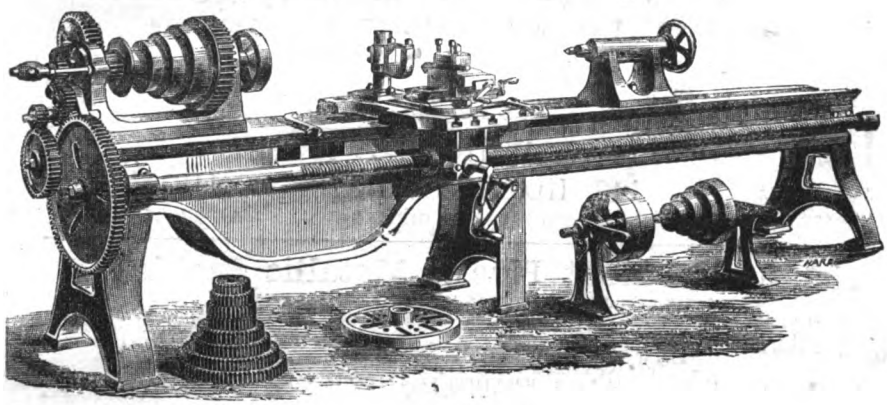
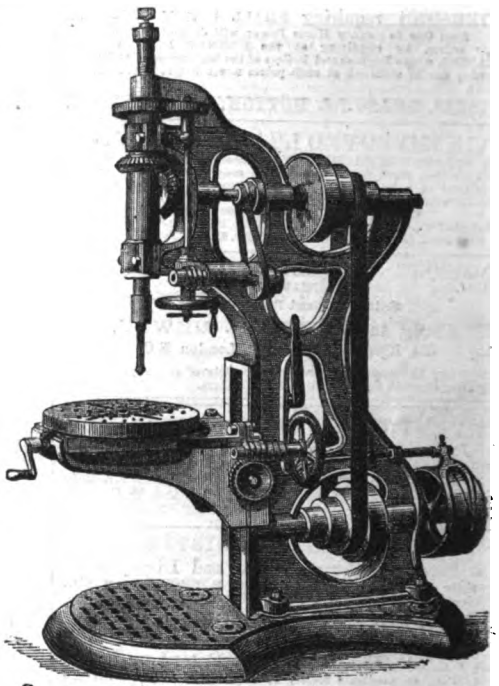
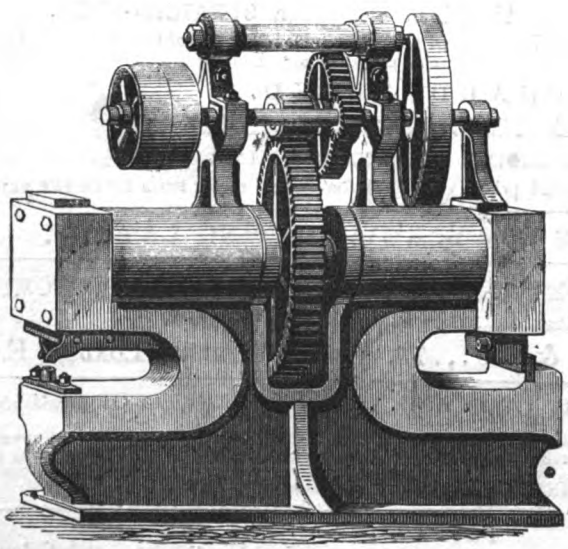
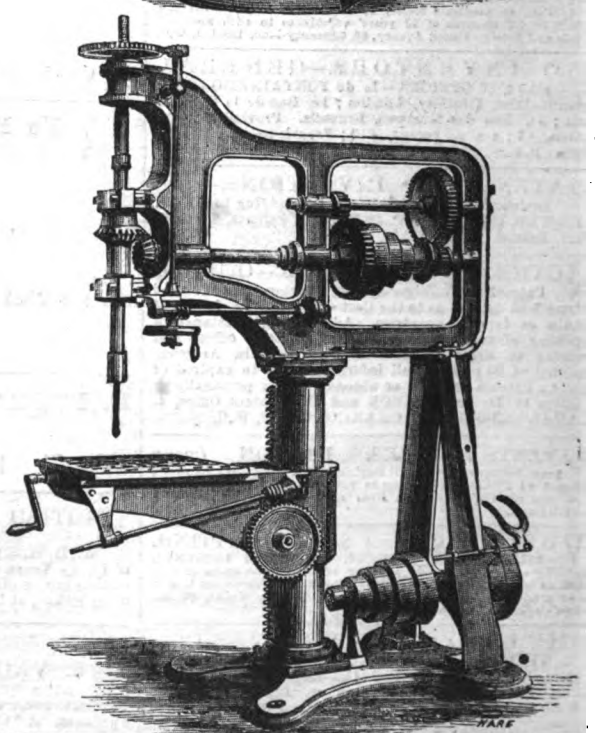
7½ "	14 "
8 "	8 "
8 "	12 "
8 "	13 "
10 "	16 "
12 "	16 "
10 "	18 "
14½ "	20 "
16 "	13 "









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ENGLISH MECHANIC AND MIRROR OF SCIENCE AND ART

Engineering, Building, Inventions, Electricity, Photography, Chemistry, &c.

VOL. II.—No. 52.] FRIDAY, MARCH 23, 1866. [PRICE TWOPENCE.

GARDNER AND ROBERTSON'S AUTOMATIC STOP GOVERNOR.

THE best steam engine that can be constructed, as regards proportion, design, and workmanship, runs very defectively unless it has a good governor. Where the load on it constantly varies, the speed will be at one time high, or at another low, if some measures are not taken to regulate the quantity of steam admitted to the cylinder.

In these engravings we illustrate a new self-acting governor which not only regulates the flow of steam to the cylinder, but also serves as a stop motion in case of emergency when the engineer is not close to the throttle valve. The ends are obtained by the construction of the valve, and the mechanism which operates it

By referring to the engraving in Fig. 1, a weighted lever, A, may be seen. This lever has its fulcrum at B, and connects with the throttle valve stem by a square socket, C, in which it is free to move up or down. This weighted lever is provided to take up the lost motion, in the joints and pins of the governor arms, and to partially balance the valve, thus rendering it easy to move, and very sensitive to the action of the arms, so that any change in the load of the engine, whether an increase or decrease, is instantly felt at the throttle valve, and more or less steam admitted as may be required. The balls tend to depress the valve, while the weighted lever tends to raise it, so that as the velocity of the arms changes, the valve always follows them, and therefore acts instantly as before stated.

FIG. 1.

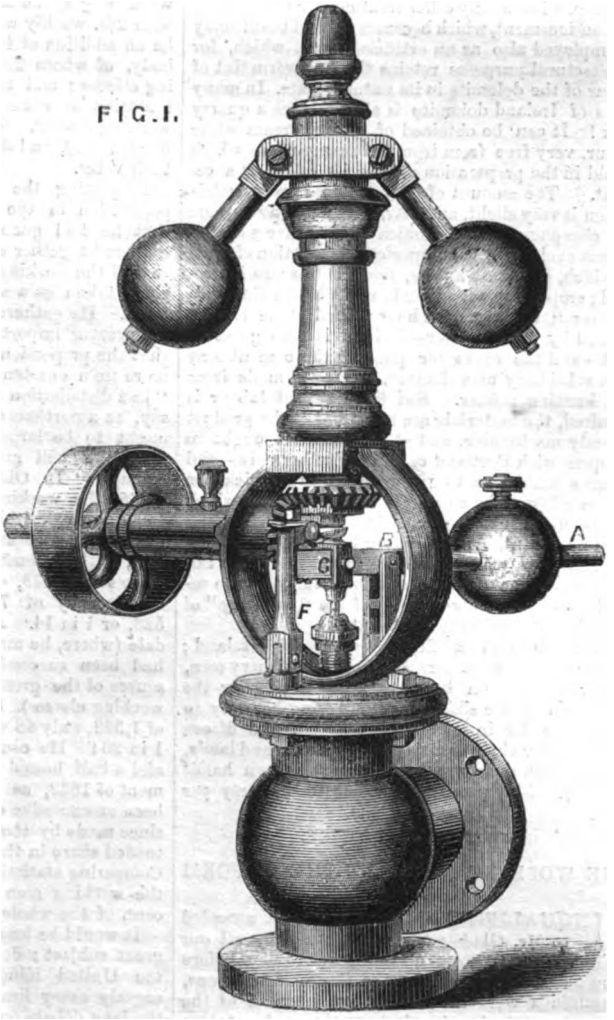
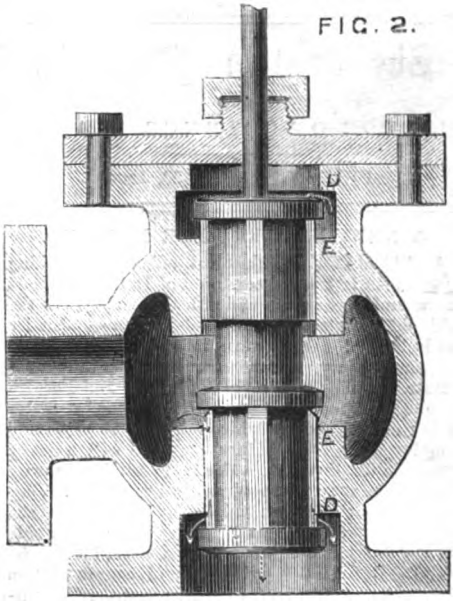


Fig. 2 shows the valve. This valve is a hollow cylinder, A, with four guiding wings, B, and three seats acting on four seats in the chamber, C. It is thus made for these reasons—being hollow and having clearance between the seats (as given by the guiding wings), it is balanced so soon as it is slightly raised from the seat, for the steam presses both on the inside and outside of it. So long as the engine runs regularly, or at a uniform velocity, the valve floats in steam, and plays between the seats D D and E E. If a belt breaks, however, or it is desired to stop the engine from any part of the building, a wire or line, led from any room, communicates with the weighted lever and raises the valve, so that its seats close the openings at D, and shuts off the steam from the engine, thereby stopping it at once. A weighted lever also furnishes a medium for regulating the speed of the engine.

This valve and governor is the subject of three patents, all secured through the Scientific American Patent Agency, the last one bearing date November 21, 1865.

The inventors and manufacturers are Messrs. Gardner and Robertson, of Quincy, Illinois, America. For further information address them at that place.

FIG. 2.



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No. 51, March 16:—Robbins's Method of Preserving Wood.—Copper Smoke and Sulphuric Acid.—On Pigments.—Perspective in its Application to Architectural Design.—Telegraphy.—Preparing Objects for the Microscope.—Photography.—The System of the Universe.—Detonating Meteors of February and November.—Trade Disputes.—Recent Researches on Metals and Alloys.—Motive Power from Ammoniacal Gas.—The Lathe and its Uses.—London Association of Foremen Engineers.—Correspondence.—Price Lists, and much other useful information.

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MIRROR OF SCIENCE AND ART

FRIDAY, MARCH 23, 1866.

A NEW INDUSTRY FOR IRELAND.

A SUBJECT which must affect all thinking men is the sad condition of Ireland. Years come and pass away, and still there rings out the old, old cry, startling and fresh as ever—"Justice to Ireland"! What cause there may be for this everlasting cry, it is not our intention to demonstrate. Suffice it that both English and Foreign capitalists shun the shores of the beautiful Sister Isle; and the labour which might be so profitably employed at home, rushes westward with a heavy curse on its lips and a desire to lift its brawny arm in the commission of political matricide. Very sad is it to think that this is and has been the case, and that there are millions on the other side of the Atlantic hating us with a hate bitter and deep. But it must be a source of congratulation to Ireland's well-wishers to learn that the Government is earnestly engaged in endeavouring to get at the "reason why" of the existing state of things; all those who really are acquainted with Irish matters are being consulted; and there remains not the slightest doubt on our mind of the intention of Government to bring forward remedial measures so soon as their information is perfected and the existing excitement has subsided. Should these measures be broad and comprehensive, there can be no doubt but that capital will seek employment in Ireland; and once set the fertile isle on a proper footing, and peace and plenty, under Providence, will also take up their abode. At present, to the majority of Englishmen, Ireland is a *terra incognita*. Many know more of France, Italy, and Germany, than of the county Galway; in truth, it is a very Herzegovina to most folks—something always turning up in the papers, the latitude and longitude of which is not very clearly defined. Capital, like a monitor, would very soon open up the land to the British school, and "to Galway and back for 50s." would become a popular tour. And then the dolor would die away and the new industry we wot of arise; for so soon as quiet reigns again, a descent is to be made on the rich stores of dolomites which Ireland possesses, and turn them into cement. Mr. Mallet, C.E., in his address to the Institution of Civil Engineers of Ireland, said great things of them, which we can simply say are perfectly corect.

Sainte-Claire Deville, the celebrated French chemist, discovered that some compounds of hydrate of lime and hydrate of magnesia afford a cement of eminently hydraulic properties, and setting rapidly under water. He has further found that the natural dolomites, which consist of carbonate of lime and carbonate of magnesia in proportions either of one atom of each or of two or three atoms of the lime carbonate to one of magnesia—if calcined at a very low red heat and ground to powder, produce, without any other treatment, a fast-setting hydraulic cement, which becomes so hard that it may be employed also as an artificial stone, which, for architectural purposes, retains the fine warm tint of colour of the dolomite in its natural state. In many parts of Ireland dolomite is abundant as a quarry rock! It can be obtained of a fine, cream-white colour, very free from iron and manganese, which would in the preparation darken its colour as a cement. The amount of heat required for its calcination is very slight, and may, with great advantage and cheapness, be communicated in furnaces heated by gas evolved by the imperfect combustion of peat, of which, goodness knows, there is to spare in Ireland; employing a modification of Charles Siemen's regenerative furnace. The calcined stone can be ground by water power—Ireland is also great in that—and the casks for packing the cement may be a subsidiary manufacture, and even made from small native timber. But little skilled labour is required, the materials are all at hand, the product directly marketable, and at a price that ought to compete with Portland cement. Furthermore—and persons ambitious to patent even a toothpick are requested to make a note of this—the process which has been given to the world by Deville is hampered with no patent. And there are tens of thousands in Ireland now whose position would be much improved—whose dolors would be changed into rejoicings—by the introduction of the "industry" of changing dolomites into cement.

There is still a fine prospect for Ireland; paper makers, engineers, ship builders, fishery men, oyster and salmon breeders, are wearying for the day when Peace shall once more wing her way to Erin's isle, for instead of getting ten and fifteen per cent. for their money in other hands and lands, they can see their way to fifty in their own hands at home. May peace soon usher in the forty per cent.

THE WORKING MAN AND THE REFORM BILL.

UNQUALIFIED approval has been awarded to Mr. Gladstone's Reform Bill by all our leading journals. From certain quarters, days before even a sign was made in the House of Commons, grumblings were heard because a member of the Government had refused to receive a deputation on the subject of the lodger franchise, but these have died away, and now the Bill has been laid before the House; and we are fully convinced that the majority of our English mechanics will find much to admire and very little to disparage therein. Its contents may briefly be summed up as follow:—

Beginning with the county franchise, it is proposed to reduce the £50 to a £14 occupation of a house, with or without land. This will add 171,000 persons—almost entirely of the middle classes—to the present constituency. It proposes to put copyholders and leaseholders within Parliamentary boroughs in the same position as freeholders. Respecting "special franchises," the Bill gives a vote for the place where he resides to every savings bank depositor of £50 of two years' standing, subject to the obligation of making an annual claim. Passing to the borough constituencies, the extensions in the borough franchise contemplated in the Bill affect two classes—those who lived in houses above £10, and those who lived in houses below that value. With regard to the first, it is intended to abolish the ratepaying clause, which would add 25,000 persons to the register, and to require that the name of the compound householder, whose rates were paid by the landlord, should be placed on the ratebook, whence it would pass by a spontaneous process to the register, and thus 35,000 new voters would be created. Respecting persons occupying portions of a house (flats for instance) and lodgers proper, they are to be placed on the register if they show by an annual claim that the premises which they occupy are of the annual value of £10. The Bill also proposes a £7 rental suffrage, which, making all the deductions requisite, would enfranchise 144,000 working men, for whereas a £10 franchise could not easily be attained by a working man who had not £2 a week wages, the £7 franchise could be reached with 26s. weekly wages. The general result will be an addition of 400,000 voters to the constituent body, of whom 200,000 will belong to the working classes; and this would amount to a representation of somewhere about two in five of the working classes. The necessity of residence will be abolished, and dockyard labourers deprived of their votes.

Respecting the present share of the working population in the franchise, Mr. Gladstone said that he had gone over 200 boroughs and had gathered together about 60, in which the proportion of the working classes possessed of the franchise, taken as a whole, was not less than one-third. He gathered 30 other boroughs, probably of greater importance, and in those 30 found that the proportion of the working classes was not more than one-tenth; and, said Mr. Gladstone, "this distribution is not only unequal, but I must say, as a northerner, that it is also least where it ought to be largest, that is, in the towns of the north. I will give you six towns by way of example. In Oldham, with a constituency of 2,665, the working classes are 315, or 1 in 8. In Halifax, with a constituency of 1,771, the working classes are 124, or 1 in 11. In Bradford, with a constituency of 5,189, the working classes are 438, or 1 in 12. In Leeds, with a constituency of 7,217, the working classes are 523, or 1 in 14. And last of all there is Rochdale (where, he mentioned, the co-operative system had been successfully worked out, and made a source of the greatest comfort and profit to the working classes). In Rochdale, with a constituency of 1,358, only 68 working men are enfranchised—1 in 20!' He contended, in a lucid speech of two and a half hours' duration, that the enfranchisement of 1832, as regards working men, had not been an excessive one, and that the great advances since made by the class entitled them to an extended share in the government of their country. Comparing statistics he showed that while in 1832 the working men qualified to vote were 31 per cent. of the whole, they are now but 26!

It would be loss of time to go further into this great subject; doubtless every working man in the United Kingdom has long ere this read eagerly every line of the proposed measure, and the long debate on it. But we cannot help drawing attention to the fact that the *Times* seems doing its best to throw cold water on both the Reform Bill and its originators. Probably it considers that Earl Russell has a taint of "the people" about him, and that the *haute noblesse* are not

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sufficiently represented in office. We have great respect for the *Times*; it a journal magnificent even in its blunders, but we fancy that even the *Times* has gone a step too far in trying to damage this Gladstone-Russell measure. We think that in stating our conviction that the Bill, so far as it goes, is all that earnest thinking men could desire, or rather, perhaps expect, we but repeat the conviction of our readers as a body. Next year we hope to see some alterations made in the distribution of seats; and, should this Bill pass into law—reducing the term in the £50 savings bank clause from two years to one and the sum to £30—from the date of its coming into operation we may look for a reduction in our annual expenditure, which is simply one-third more than it ought to be.

And now we have done with politics; it is a field we do not care to enter, but the subject is in every man's mind, and—it is of importance to every lover of his country, every English mechanic.

ELECTRO-METALLURGY.

PLATING is similar in principle to typeing, but a little instruction is necessary:—In the first place a solution of cyanide of potassium and silver, or as it is called Argento cyanide of potassium, takes the place of the solution of sulphate of copper in the precipitating trough.

Let me caution all who attempt to make or use this solution that it is a *deadly poison*, both as cyanide of potassium, or as the Argento cyanide. It is certain death in a few minutes to taste it, yet its smell to me is so alluring that I have frequently wished to know the taste; it is fatal should it enter a scratch in the skin, and I believe photographic artists suffer from its effects by using it only. The toy known as Pharaoh's serpents contained this, hence their danger. They were dangerous also on account of the mercury, in short they were composed of the sulpho-cyanide of mercury. I cannot point to any work on chemistry where such a villainous character is given to this salt: the most severe I have seen lately says it is *highly dangerous*. I think that was Justus von Liebeg. Brande does not mention it, but I should for ever blame myself if any reader of these chapters met an injury for want of a caution.

One way of preparing the solution is to purchase an ounce of nitrate of silver, dissolve in a pint of water, and add a solution of salt and water, until a white precipitate, which is the chloride of silver, no longer falls, allow it to stand in a dark place a few hours, to settle and become compact, then pour off the liquid and add clean water; do this three or four times. Dissolve now, one ounce of cyanide of potassium in a gallon of water, and mix this with the chloride, a clear solution should thus be obtained, which will contain nearly one ounce of silver; it is then fit to form the bath. A silver electrode now takes the place of the copper.

If you can purchase the chloride of silver dry instead of the nitrate, of course it saves the trouble of precipitating, but the process is not difficult, and as nitrate of silver is manufactured so largely now for photography, it can be bought much cheaper than you can make it. Should you require to buy more cyanide of potassium than you require for immediate use keep it in a wide-necked stoppered bottle, secure from the air and water, otherwise it changes into cyanate of potassa. Should part of it so change, the remainder is not useless, but there is that much wasted.

Erratum.—In the last chapter lead should not have been classed with zinc, &c., as requiring a special solution.—Momus.

Testimonial to Mr. George Potter.—Last week Mr. James White, M.P. for Brighton, presided over a meeting of about 250 working men, assembled in one of the rooms of Exeter Hall, to present to Mr. George Potter, who has taken a prominent position in connection with agitations and disputes of artisans, &c., an address, expressive of their esteem, together with a purse of 300 guineas, contributed mainly by working men, but including also subscriptions by eight members of Parliament and about thirty gentlemen belonging to the upper and middle classes.

ON PIGMENTS.*

II.

Until lately, owing to the great scarcity and dearness of the metal from which Cadmium yellows are obtained, they were little known. Cadmium is, however, now found more abundantly, and consequently the yellows have become proportionately cheap and plentiful.

Chrome Yellow. Chromate of Lead. The power and brilliancy of the various chromates of lead—lemon, pale, deep, and orange, have caused them to be much employed. Yet they are rank in tone, and are not to be depended upon for permanency. The lead base of the chromates is liable to blacken by foul air, and the lighter yellows have a tendency to become greenish in their hue. Of the chromates of lead, the Chrome Orange is the most durable and the least exceptionable. It is, however, liable to the changes of the lighter chromes, though in a less degree.

Yellow Ochre. There is a great variety of yellow earths falling under this name. They are found abundantly in most countries, and especially in our own. Their tints range from a bright, though not vivid, yellow, to deep low tones of brown yellow, which latter is known under the name of Brown Ochre. The finest kind of Yellow Ochre is that known as Oxford Ochre, and this is the kind chiefly used in painting. It is a most serviceable pigment in oil, fresco, and distemper, and it is not prejudicially affected by light, impure air, or other causes of deterioration and change.

Naples Yellow. Antimoniate of Lead. A light, warm, opaque yellow, formerly much used. It is, however, so liable to change by admixture with pigments that contain iron, such as the ochres, Prussian Blue, &c., and even by contact with metallic iron, a steel palette knife, for instance, that its use is now but very limited. All the tints of Naples Yellow are readily and accurately imitated by admixture of deep Cadmium Yellow and white, and these are now employed to replace the untrustworthy tints of the Naples Yellow pigment.

Raw Sienna Earth. Also a native pigment; in many respects of great value. It has more transparency than the ochres, and it is equally permanent.

Burnt Sienna Earth is the raw sienna earth burnt, and is of a rich orange russet colour. By the operation of burning, it acquires warmth, transparency, and depth. It is a very durable and eligible pigment.

Vermilion. Sulphuret of Mercury. There are several varieties of this pigment, the orange, the pale, the deep, and a purplish tint, known as Chinese Vermilion—the latter now but little used. The difference of tint between the several kinds is but slight. The pale and the deep vermilion are those mostly employed in decorative painting. Neither light, time, nor foul air, effect sensible change in true vermilion. It is frequently adulterated with red lead and other inferior pigments; but when unmixed and pure, vermilion is permanent, and eligible in oil, distemper and fresco.

Indian Red. A native earth containing a large proportion of peroxide of iron. It varies considerably in its hues, and is valued for the clearness and soft lakey tone of its tints. It is very permanent, and is an eligible pigment in oil, distemper and fresco.

Light Red. Calcined yellow ochre. The brilliancy of the red being in proportion to the clearness and purity of the ochre employed. Mixed with white, light red gives a beautiful range of tints of pale and deep flesh colour.

Venetian Red. Prepared from calcined sulphate of iron; somewhat similar to light red in tint, but more powerful, and of a more scarlet hue. Very permanent, and has all the qualities of good ochres.

There is a class of red pigments consisting of native earths, such as red ochre, Armenian bole, red chalk, &c. These red earths abound in England. They are all useful and permanent pigments of more or less value, according to the body they possess and to the brightness and purity of their tints.

With these may be named the Colcothars, mostly obtained, like Venetian red, by the calcination of sulphate of iron. They vary in tint, according to the process of manufacture, from full, low toned red to brown red and purple brown. They furnish very durable colours, which unite well with all other pigments. The whole of the iron pigments give very permanent, sober tints.

Madder Lake. Of all the transparent red lakes, and they are very numerous, those obtained from the madder root possess the most desirable qualities. They are brilliant, transparent, and, above all, permanent. They do not change by the action of light or impure air, and they are not injuriously affected by mixture with other pigments.

An extraordinary variety of lakes of different hues, all permanent, are obtained from the madder root in addition to the red lakes. They are known by the names of flesh madder, Rubens' madder, madder purple, madder brown, &c. Of these the two latter are the most important. The use of madder purple, chiefly on account of its high price, is almost entirely confined to water-colour drawings. The madder brown is very much cheaper, and is more generally employed. It is a powerful marrone brown of great beauty, depth and transparency.

Lake, crimson, scarlet, and purple. The lakes obtained from cochineal are all more or less affected by strong light, which weakens their tints, and in time deprives them of colour. Their extreme beauty and transparency, however, causes them to be extensively employed in all kinds of ornamental painting where permanence is not absolutely demanded. The deeper tints, the purples, are the most permanent.

A low-toned purple lake is obtained from lac, which is tolerably permanent. Red lakes are also prepared from a variety of dye woods which yield red tinctures. These are, without any exception, fugitive.

Genuine Ultramarine, the most celebrated of all pigments, ancient and modern. A most exquisitely beautiful blue, varying from the utmost depths of shadow to the highest brilliancy of light and colour; transparent in all its shades, and pure in its tints, so eminently permanent that it remains perfectly unchanged in the oldest paintings. Unfortunately, the great expense of fine genuine ultramarine forbids its extensive employment in decorative painting.

French Ultramarine. Though wanting the high merits of genuine ultramarine in brilliancy and purity, the imitation pigments, known as French Ultramarines, effectively replace the genuine colour for almost all purposes. The imitation ultramarines possess, in a subdued degree, the characteristics and qualities of the genuine. They are brilliant, transparent, powerful, and permanent. They are now made, by various processes, of different degrees of excellence, at prices varying with their quality, and of tints ranging from pale to deep.

Cobalt Blue, a clear, light, brilliant azure, of great value where clear light blue tints are required. These tints approach in brilliancy the paler tones of ultramarine. Cobalt Blue has not, however, the transparency and depth of ultramarine. This pigment may be considered to be permanent, the slight changes to which it is liable affecting it but rarely.

Smalt is an impure vitreous Cobalt Blue, varying much in its qualities. The finer kinds are occasionally used in decorative work. It is almost always of a coarse, gritty texture, and of little body. Smalt is, on this account, sometimes applied to work by strewing the dry powdered pigment upon a flat ground of white or blue oil paint immediately after the latter is laid on, whilst it yet remains wet.

* From "The Art of Mural Decoration." Winsor and Newton, 88, Rathbone-place.

It has been suggested that a large fraction of the heat by which the temperature of the body of the sun is maintained is the result of the continual recurrence of the process of magnetisation by the impinging action of the ether of space. The penetration of cosmical matter into the photosphere is another source of heat.

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THE ART OF COINING.

IV.

Into the hopper or dish which surmounts the marking machine the blanks are discharged from a bag, and an attendant guides them down to the cup at the base of the hopper, taking care that they fall horizontally, and pile themselves regularly in it. When the transference of a strap from a loose to a fast pulley puts the grooved ring in motion, the ratchet-wheel also turns, and its miniature teeth catch, one by one, the blanks which rest upon its edge and forces them down the slide. The running ring, by force of friction, causes the blanks to revolve horizontally between itself and the grooved segment opposite, and thus administers to each a severe squeezing. They fall in rapid succession—at the rate, indeed, of six hundred per minute—into a basket placed below for their reception. It is necessary, therefore, for the workman in attendance to have a quick hand and a sharp eye to feed the cormorant machine with sufficient food to meet its huge demands and its rapid digestion.

In order that the action of this ingenious contrivance may be completely understood, we append an illustration of a Mint marking machine, by the aid of which the operations just described will be readily traced. As has been stated, this apparatus is adaptable for every denomination of coin, the space between the living and dead grooves being regulated by "set screws."

It is thus of universal application, and the changes are effected in a very short time. Its rapid movement and small liability to disarrangement form its principal recommendations to the favourable notice of scientific and practical men. Granting, now, that a batch of golden discs have passed through the marking process, and thus been supplied with their preparatory rims, it will be well to accompany them to the next department, which has very much the appearance of a bakehouse, but is, in fact, the annealing room.

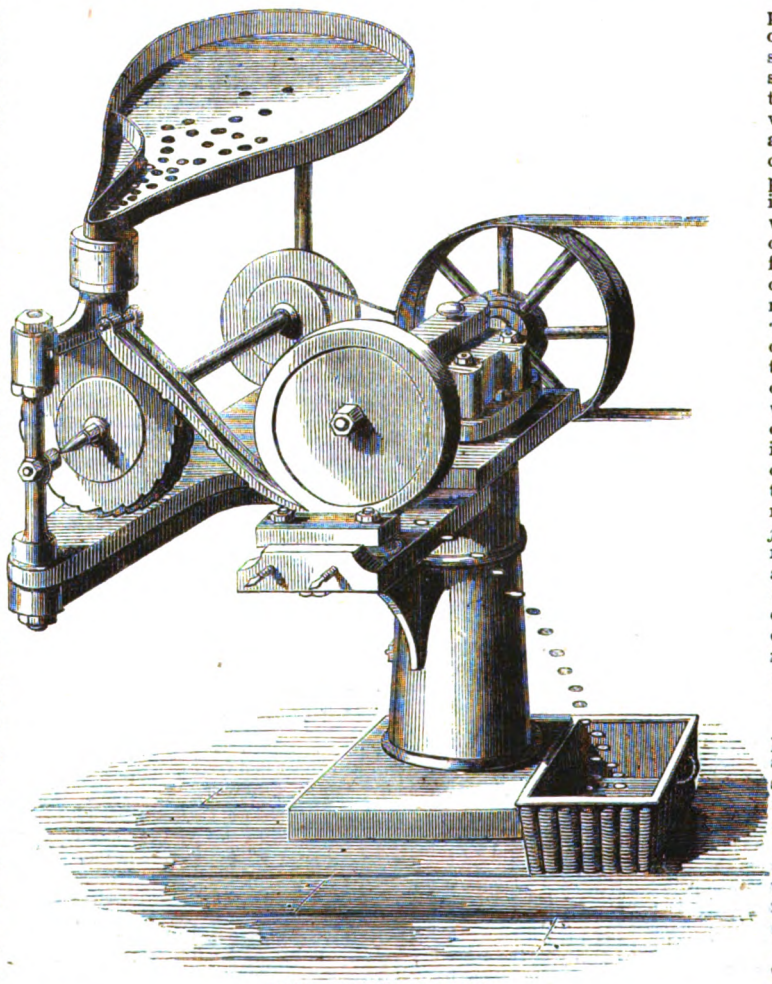
The rolling and drawing to which the fillets of gold from which the blanks were punched have been subjected have rendered the latter hard and unyielding, whereas they should be soft and impressionable. Fire and water are the agents which will produce those effects, and to their action the blanks must now be submitted. The annealing room is furnished with six ovens on the reverberatory plan, and which are heated by means of Juckes's self-feeding and smoke-consuming furnaces. Numerous cast-iron pans, each capable of accommodating 2,804 pieces of gold, small iron carriages for supporting the charged pans while in the ovens, counterpoise weights for balancing the oven doors, trays, and other minor accessories, make up the fitments of the room. In recounting the annealing episode in the parentage and birth of our "yellow boys" it will be convenient to confine attention to one detachment of them, because the mode of treatment is the same in reference to the millions which annually leave the royal establishment, and reach the innumerable channels and creeks of general circulation. The workman's first duty in the annealing room is to deposit the contents of a bag into a fluted mahogany tray, and to shake the marked blanks into *rouleaux*. By the side of the tray stands the annealing box or pan, and to this the *rouleaux* are speedily transferred. They rest on their edges in rows, and are then covered with two plates of wrought-iron, luted round with fire-clay so as to exclude the air and prevent excessive oxidation of the alloy during the heating operation. The loaded pan is placed upon the oven carriage, and the whole is backed at once into the fiery prison-house. The door of the oven is closed, and the annealer, like a careful baker, keeps watch and ward upon the progress of his batch. This he does by peering at intervals through a hole in the oven door.

About forty-five minutes serves for heating to redness the box of gold, and then it is withdrawn and deposited on the stone floor to cool. Arrived at the black stage of temperature the lids are removed, and the pan is inverted over a copper dish, into which the blanks, of course, fall. The dish and its rich contents have now to be removed to the pickling and bath-room, where are boilers for hot pickle, cisterns for cold, and abundance o water baths. The quenching arrangement is the primary one attended to in the pickling apartment, and it is effected by dropping the gold into a colander resting in a vessel of cold water. The completes the softening business, but it leaves the blanks somewhat discoloured. They have to be treated for this complaint by the exhibition of boiling-hot sulphuric acid (diluted). The colander allows this to be accomplished readily, and with its contents it is placed in the open boiler of acid. A sharp stirring ensures the contact of the surfaces of all the discs with the potent fluid, which quickly absorbs all the oxidised alloy.* The colander is then conveyed to the opposite side of the room and treated to a douche bath, which washes away all traces of pickle, and leaves the blanks of a bright yellow hue indicative of their sterling characters.

* This waste has been provided for in the melting department, and it leaves the gold of the exact standard required.

Silver blanks, it may be observed, undergo analagous treatment as regards annealing and pickling, although stronger doses of acid are administered, and they emerge from their final bath in a "frosted" condition. Bronze blanks, after annealing, remain many hours in cold acid, and are then more completely brightened by mechanical friction in sawdust.

The drying room is the next destination of our yellow-faced friends, and a sieve placed on stretching bars over a hot-plate receives them. The plate itself is heated by flues passing beneath it, and it is covered by a layer of beech-wood sawdust. Some of this latter is shovelled into the sieve, and a kind of dry shampooing operation is performed by the workman in attendance upon the blanks. By dint of rubbing and shaking, and repeated importations among them of clean and warm sawdust, all moisture disappears very soon, and the glittering pieces are left high and dry upon the meshes of the sieve. A hot-air bath, fitted with what is technically known as a muffle, and which greatly resembles a primitive coffee-roaster, completes the drying-out process, and rids the blanks of every particle of sawdust, which falls through the perforations of the muffle.



MINT MARKING MACHINE.

Now, therefore, the pieces are prepared for stamping; and while other batches are, in rapid succession, passing through the various stages from the cutting-room to the drying-room, we may advance with these to the coining press, and witness their conversion into current money of the realm. In the press room weighing is again put into practice, as a check upon the workpeople and a guide to the officer in charge. As the candidates for sovereignty are now, however, divided into smaller quantities, namely, of 15 lb. troy each, they are virtually counted, for the law does not allow of individual variations which would equal the weight of a single sovereign in the gross weight just named. When 15 lb. of the precious material is placed in the scale the weigher is quite certain that he has 701 blanks, and this quantity is known as a "journey," from the Norman word *journée*, and which originally signified, when hand coining prevailed, a single day's work. Of course, in balancing up, the officer of the department pursues a similar course of combined weighing and counting, and thus assures himself of receiving back as many pieces as he gave out for stamping.

The press room contains eight power presses for general coining, and one hand press for stamping silver pennies. They are arranged in single file along the middle of the handsome apartment; and a platform of some 2ft. 6in. in height, covered with iron plates, surrounds them. The presses are very compact machines and their beds—solid masses of cast-iron of great depth and weight—rest upon stone foundations. An arched tunnel at a considerable depth allows access to the holding down bolts of the whole series of presses. A good idea will be gained of these mechanical money-makers from our artist's delineation of a Mint Coining Press. The whole of them were constructed by the celebrated firm of Boulton and Watt, and they are on the vertical screw principle, as distinguished from the lever press now growing into favour in some foreign mints. Through the centre of the press passes a coarse pitched treble threaded screw of five inches diameter. This works freely in a brass box or nut of considerable length. The lower end of the screw which is of wrought-iron

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has a plug of hardened steel fitted into it, and this is highly polished. Below the steel plug, and so disposed as that its upper surface, also of hardened steel, shall come into contact with the screw-end is the obverse die receiver *a*. It will thus be gathered that a movement of the main press screw up or down will cause the die receiver, and the die also if it be present, to ascend or descend. Firmly screwed to the bed of the press and immediately below the upper die is the lower or reverse die receiver and die with its adjusting screws. Screwed to the left side of the press is the blank feeder or layer-on *b*, an ingeniously contrived apparatus, the mission of which is to convey discs to the dies for striking, and to displace those which have been struck.

(To be Continued.)

THE SYSTEM OF THE UNIVERSE.*

(Continued from page 371.)

THOSE who have not learnt to distinguish the orbital paths of the heavenly bodies from their paths through space, will be perplexed by a fancied complexity in the mutual relations of the several simultaneously revolving concentric systems, and, seeing only a vision of motion warring against motion, may be tempted to deny the possibility of solar motion altogether. Such persons when walking up and down the deck of a steamer under way, should consider how completely their own uniform pace on the deck is independent of the progressive movement of the vessel, and how tranquilly it is carried on (in smooth water) notwithstanding that progressive movement, although when computed from a coast line, along which they may be passing, the personal velocity by the land diminishes in walking against, but increases in walking in the direction of, the advancing steamer. They will then perceive that the motion of the individual members of systems is not affected by the proper motion of their centres, but continues its own course and rate as tranquilly as though those centres were at rest.

This is an important astronomical principle; but the general force of the example through which it is learnt is sometimes overlooked, because the single circle of comparison, the zodiac, cannot give its evidence as a continuous stream, like the coast line, when the concentric relations of the solar system are considered, its testimony then being only reached by computing the residual change from epoch to epoch; and it is in this manner that the real nature of the several inter-dependent motions has been determined.

The vastness of the scale of the motions of the concentric, celesti-polar theory, deserves special attention. Some idea of this may be formed from the fact that such a base line as the mean diameter of the earth's orbit, computed at more than 180 millions of miles, fails to produce an appreciable divergence from parallelism in its polar axis—a sensible conical motion, or nutation, being only reached through the diameter of the orbit of the sun—its culmination in the passage round the orbit of the central sun, marked by the successive substitution of one star for another, as the polar star, in succeeding epochs of time. But by far the most convincing evidence of it is found in the persistent aspect of the starry firmament, in which it is extremely difficult to detect the existence of any change in the inter-stellar relations the only change that has hitherto been determined having been attributed to a proper motion of the several stars implicated.

A change has been noticed, however, in the position of some of the stars, such as Sirius, Arcturus, and Aldebaran, which points to the possible action of a general cause; for these stars are slowly passing to the south. This is an important fact with reference to the theory I am advancing, for it is possible that this southerly recession may be an apparent, and not an actual motion; and in reality depend upon a drawing of the solar system towards the north.

Could this be proved to be the case, it would furnish the first evidence that concentration is in the act of taking place throughout the entire compound system.

But concentration is taking place in the intra-zodiacal system. The progressive shortening of the tropical year, already noticed, proves this. So also does the secular diminution in the obliquity of the ecliptic; as well as that advance of the position of the moon in its orbit attributed to a secular acceleration of its motion; and the progressive diminution in the eccentricity of the earth's orbit; and as, even apart from the motion of the centric sun, eccentricity in the orbit of the central sun would cause that body to draw its entire system nearer to the celestial polar centre, as it drew nearer to the centric sun, it can, therefore, be considered as established that such a general systemic concentration is in actual progression.

The possibility of an attraction acting upon the earth from the north celestial pole, is pointed at by the analogy of the attraction of the earth upon the moon, in virtue of which the latter always turns the same hemisphere towards the terrestrial systemic centre of gravity.

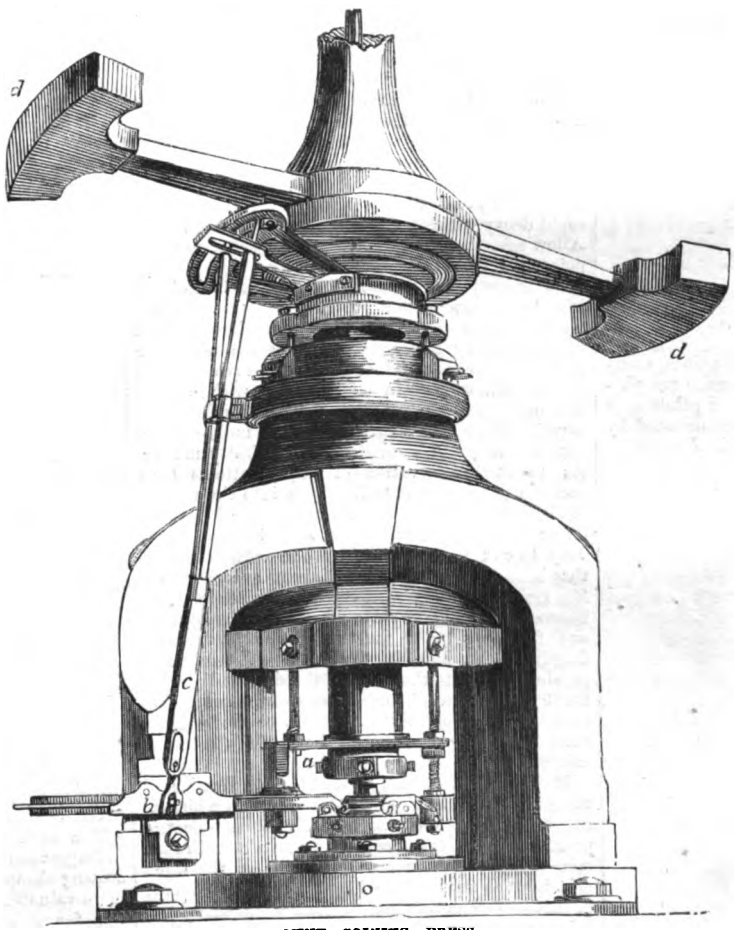
The evidence that such an attraction has acted upon the earth is found—1. In the accumulation of the land in its northern hemisphere. 2. In the configuration of its continents, which, for the most part, taper towards the south, as though the superficial grouping of the land had taken place during a process of sedimentary deposition towards the north. 3. In the much greater depth of the southern than of the northern oceans, which shows that the accumulation of the land in the northern hemisphere is not the result of a mere accidental surface arrangement, but affects the whole mass of solid matter.

The evidence that such an attraction may be still acting on the earth is found—1. In the magnetic storms, which occur simultaneously on the earth and the sun, notwithstanding their great distance apart, accompanied by—2. Luminous auroræ, which, from the general direction of their lines of radiation, and the flow of their luminous pulsations from the north, are termed Northern Lights. 3. In the general set of the magnetic currents, as tested by the action of the magnetic needle.

The evidence that it is so acting is found in the gradual elevation of the land in the northern hemisphere, which progressively increases its ratio with approximation to the pole.

An exception must be noticed here in the equally slow subsidence of the south coast of Greenland. This is the result of the action of a physical law, in virtue of which the relations of the polar axis are inverse to those of the equatorial diameter; so that any mechanical alteration in the dimensions of the one must be accompanied by an opposite change in those of the other. This law is aided in its operation by the law of revulsion, with a view to the preservation of a stable equilibrium in revolution. Under the combined action of these laws, the gradual increase in the force of the polar attraction produces a gradual elongation of the polar axis—an equally gradual contraction of the equatorial diameter. The great fissure of the Atlantic is one of the media through which these relations are rendered possible—the contraction of the equatorial diameter being accompanied by a slow approximation of its opposite shores, during, and under the influence of which a gradual subsidence of the ocean bottom occurs; this subsidence drawing down the coast of Greenland with it.

* Henry Pratt, Esq., in *The Reader*.



MINT COINING PRESS.

WATCHMAKING.

If we are to believe the evidence of our eyesight—if immense outward show is to be taken as a sign of the banking account kept in the safe within—then, indeed, do our home watch manufacturers not only keep pace with, but are very much in advance of foreign producers, and British watchmakers and their operatives are far from being in the starving condition predicted for them before the era of free trade. The tremendous "consumption" of foreign watches in this country is a thing to be noted. During the year 1865, 91,595 gold and 200,418 silver watches, or in all nearly 300,000, were manufactured in Besançon, France, and a heavy percentage of these were consigned to the British market. How many tens of thousands find their way from Germany to England we are unable to say, but the number is immense; and yet the home trade grows and prospers, and gives every sign of flourishing for many a century to come. That good and cheap watches of English manufacture are in great request may to a certain extent be proved by a

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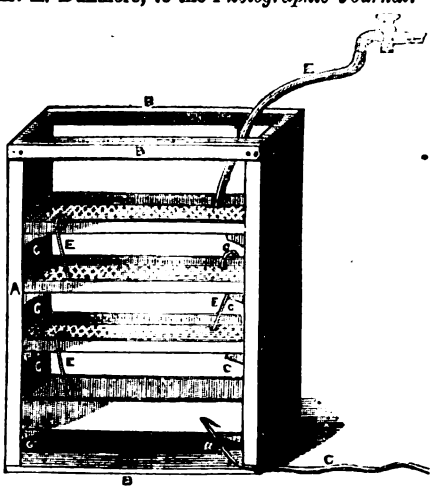
glance at the splendid premises now finished in New Bond-street for Mr. J. W. Benson, of "workmen's watch" celebrity. The building, altered by Messrs. John Drew and Co, was formerly the well-known banking house of Cale, Martin and Co., and it now presents a richly unique appearance. The front consists of two windows, each 21ft. long, divided by a spacious lobby, the floor of which is laid with encaustic tiles. The entablature, extending the whole length of the front, is of Portland stone, supported by columns and pilasters of lizard serpentine marble, on rubbed Portland stone. These columns have fluted and gilt caps and moulded bases, the arches being also moulded, and the spandrels engraved and gilt. Without entering further into particulars we may say that the shop is well worth a visit, when it will soon be made apparent that the support Mr. Benson has so long and diligently solicited has been liberally "donated," as the Yankees phrase it. Just now, too, Mr. Benson has on show at his west-end establishment a clock, which may justly be described as unique of its kind, and which is remarkable for its size, beauty, and value. The design, by Carrier, the celebrated French artist, is a graceful female bronze figure, standing on a column of onyx of every variety of tint, blended in the most artistic and effective manner. The figure and pedestal are more than 11 feet high, and the first holds in its hands a pendulum that, by an ingenious contrivance, is connected with the movement of the clock. This piece of mechanism was constructed by order of the French Government, to be presented as a testimonial to a distinguished member of the Legation in England.

Photography.

A METHOD OF CONSTRUCTING A CHEAP AND EFFECTUAL WASHING-APPARATUS FOR PRINTS.

A method for thoroughly washing prints, easily constructed and of little expense, adapted for photographers having a limited number of prints or a small supply of water, has been communicated by Mr. E. Dunmore, to the *Photographic Journal*.



The materials required are a few pieces of board, nails, glass, india-rubber tubing, galvanised-wire netting, and shellac varnish. Two pieces of board, A, A, are joined firmly at the top and bottom by cross bars, B B, B B. Strips of wood, C, C, C, C, are fastened at intervals upon the inside of the boards A, A, to form supports for the wooden dishes, D, D, D, D, which are made of wood, with strips of the same nailed round the edges of the upper surface, and varnished water-tight by the shellac varnish, and about two inches deep; each dish is connected with the one below it by means of a glass tube, bent to form a siphon, E, E, E, E. On the bottom of each dish a piece of the galvanised-wire netting is placed, a little curved upwards, in the centre.

The *modus operandi* is, first, to connect the elastic tube, F, with the water tap, and the lower one, G, with the drain, or wherever the water is required to be conducted. This being done, fill each dish with water, and place the prints to be washed above the wire net in each dish; see that the siphons act properly, then turn on the water. The wire net will prevent the prints sticking to the sides or bottom of the dish, and the siphon will remove the contaminated water from under the prints, securing a current of fresh water through the whole series of dishes. It will be seen upon referring to the diagram that the lowest dish is deeper than the others, and the siphon passes through the side, into which it is cemented; this is merely for the sake of avoiding wet and dirt in the place where it may be used. The size and number of the dishes may be varied at pleasure, each being independent of the other. The current of water can, of course, be regulated by the size of the siphons, which, it is needless to remark, must be of exactly the same size, the supply of water from the tap being kept equal to the discharge from the waste pipe. When once started, it requires no attention until the operation of washing has been continued sufficiently long, the wire preventing the prints sticking, or the siphons from being clogged, &c.

RECENT RESEARCHES ON METALS AND ALLOYS.*—II.

Although the oxidation of iron, or its rapid destruction under the influence of the carbonic acid and oxygen of the air, is a source of great advantage to those who manufacture this article, still in many instances it is a source of annoyance to those who possess articles made of that valuable metal, and in others it is a national loss, as in the rapid decay which our iron ships of war undergo. Allow me, therefore, to say a few words on these points.

It is easy to preserve small articles made of iron from rust, either by plunging them into a weak solution of caustic alkali (whether the iron is preserved by a peculiar action of the alkali, or because it prevents the action of the carbonic acid of the atmosphere in conjunction with oxygen and moisture, are points to be determined), or covering them with a varnish made of india-rubber, gutta-percha, and a small amount of fatty matter. As to the preservation of ships' bottoms from corrosion, without entering here into the various methods that have been proposed of late to effect this important object, still I deem it my duty to call your attention to one or two methods that have been tried with apparent success; thus Mr. Leach has applied on the iron surface of ships' bottoms a coating of gutta-percha or other cement, and fastening by it sheets of glass of about one-fourth of an inch in thickness. The glass is previously heat to the shape of the ship, and pierced for the reception of the screws or bolts, which are preserved from immediate contact with the metal bolts by coating them with a little of the fastening mixture.

M. Becquerel relates, in the *Comptes Rendus* of the Academy of Sciences, 1864, the results which he obtained by the application of his galvano-electric process on the iron keels of some of the French men-of-war. This process is based on the same principles as those adopted by Sir Humphry Davy, in 1824, for preventing copper sheathing from being rapidly corroded by sea-water, and which consisted, as you are aware, in attaching at various distances blades of zinc between the wooden side of the vessel and the copper sheets, or, what effected the same purpose, in using brass nails for fastening the copper to the sides of the vessel.

M. Becquerel employs zinc in connexion with iron, thus establishing a galvanic current which renders the iron, like the copper in Sir H. Davy's experiment, electro-negative, or possessing the same kind of electricity as oxygen, therefore communicating to it the property of liberating oxygen from any compound instead of absorbing or fixing it. M. Becquerel has proved that the galvanic action of the zinc on the iron exercises its influence on the whole of the iron surface of the ship, but nevertheless that its influence decreases as the square of the distance, and consequently that its action is only sufficiently powerful to preserve iron from corrosion for a limited distance, and consequently the preserving bands of zinc must be placed at short intervals from each other.

Mr. Johnson and myself published, as I hope you will remember, in the *Journal* of the Society two or three years since, two papers bearing upon this same subject, the first paper containing facts exactly identical with those published in 1864 by M. Becquerel; the second showing the advantage that would be derived by ship-builders in using galvanised iron plates instead of wrought iron ones for plating our men-of-war, for you are aware that the attack of sea-water on iron plates in contact with oak was very great; being 2·880 as compared with galvanised iron, which was only 0·095, all the circumstances of action being equal in both cases.

But the most important result that Mr. Johnson and I have arrived at on this point, is the demonstration in a paper we have published on "The Action of Sea-water on certain Metals and Alloys," that the action of sea-water on lead is nearly *nil*, as seen by the following table:

Action of Sea-water upon Metals.

1 Metre.	Grammes.
Steel	29·16
Iron	27·37
Copper (best selected)	12·96
Do. (rough cake)	13·85
Zinc	5·66
Galvanised iron (Johnson's process)	1·12
Block tin	1·45
Stream tin	1·45
Lead (virgin)	trace
Lead (common)	trace

This metal can, therefore, be used with great advantage to preserve the keels of iron ships from being corroded by the action of sea-water, and that the objection which might be raised as to its softness might be easily overcome by adding to lead a few hundredths of either arsenic or antimony, which would increase its hardness, and thus render it better fitted for the purpose referred to. From experiments that we have made we can further state that, in our opinion, Munts's metal is a far superior article to copper for sheathing ships.—(See *Society of Arts' Journal*, April 21, 1865.)

As a few ladies have done me the honour to attend these lectures, it may be interesting to them to have a simple method of cleaning silver or silver-plate without the trouble of employing rouge or other cleaning powder, which, besides rapidly wearing off the metal, takes up much of their servants' time. It consists in plunging for half-an-hour the silver article into a solution made of 1 gallon of water, 1 lb. hyposulphite of soda, 8 oz. muriate of ammonia, 4oz. liquid ammonia, and 4 oz. cyanide of potassium; but, as the latter substance is poisonous, it can be dispensed with if necessary. The plate being taken out of the solution, is washed, and rubbed with a wash leather.

Improvements have also been made of late in coating cheap metals, such as iron and brass, with more valuable ones, so as to enhance the value of the fancy articles made with them. If you remember, I referred to a process devised by M. Mudry for coating cast-iron with copper or bronze. The method that I wish now to bring before your notice is one devised by M. Weil, and is based on the same principle as the one which has been in practice for some time in tinning iron pins, or covering brass with gold—viz., plunging the article to be coated into a boiling alkaline solution of a salt of tin, or a salt of gold; and, in the case of M. Weil, into one of copper, which consists of an organic salt of copper (say the double tartrate of copper and potash) with an excess of alkali, taking care that the cast or wrought iron to be coated is in contact with a brass wire during the operation.

I shall now take the liberty of dwelling for a short time on various memoirs which have been published in connexion with the physical properties and chemical composition of alloys.

* Abstract of Lecture by Dr. F. Grace Calvert, F.R.S., F.C.S., being the 6th Cantor Lecture at the Society of Arts, May 16th, 1865.

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REVIEWS.

Researches on Solar Physics. By WARREN DE LA RUE, Ph.D.; BALFOUR STEWART, M.A.; and BENJAMIN LOEWY. London: Taylor and Francis.

The work of the sun, evidenced momently, has for ages been the subject of investigation by philosophers; far back in time men have given themselves up to observation of the orb of day, which has been and still is worshipped by many as the Great Creator. And when attention is given by even the most superficial to the consideration of but a trifle of that great labour of Nature in which the sun is so powerful an agent, the wonder at the worshipper is lessened, and it is seen that but one step separates his ideal from the real—that he has mistaken the natural effect and appearance for a superior and infinite Cause. Whence comes this never-failing store of heat and light? asks Mr. Glaisher. With almost eagle-eye has he gazed at the luminous mass, and in manner tried to gauge and test the space between it and us. Spectrum analysis says that an ever-active combustion of many metals is going on in the sun, and that the result of this energy is, light. Look at it from whatever point we may, the "study of the sun" is one of the most important to the man of science. But, many maintain the man of science is very apt to ignore a very simple-looking—thing, that the sun in the expanse exists and is kept continually supplied with life, because there exists a certain superior Sun which gives and is ever giving life and light to a "matter" which is as superior to our gross earth as is the light of day compared with a tallow candle. And further, that no true knowledge of the forces existing in and proceeding from the sun can be arrived at until such times as attention is paid to those higher laws, to which the intellect is more nearly allied in its interiors. Be that as it may, it does not detract from the force of the statement that the subject of "the sun" is a great one. And so, of course, are its "spots"—for we are told there do exist spots on the sun—or rather, by some, that the internal mass reveals itself at intervals by throwing off, a law which has no "relative" in our sublunary sphere, its incandescent covering, and revealing the "blackness within." This may appear to some as very strange; we can assure them that the belief is held by many at the present time; though that, of course, does not make the interior blackness of the sun any more a fact. Probably the holders of the "ever-burning metal" theory will be inclined to think that from the interior proceed the metals which are being burnt up, and, calculating the mass of the sun, and the rate of combustion, may yet tell us to a day or so when our great luminary will be snuffed out and the world either set up luminosity on its own account or perhaps cease to exist. Certes, if they do so, they will be more comforting to this generation than was Mr. Miller—the founder of the Millerites—who, it may be remembered, calculated, in eight different ways, that the earth was to be upset in the year 1843, in very suspicious proximity to the 1st of April. As that event, we believe, did not come off, the mighty sun rising from his "ocean bed" as usual, the mantle of Miller was handed over to a respectable Presbyterian, who also made a miscalculation. For still the sun goes shining on, giving life and heat and light.

Galileo, in 1610, discovered "spots;" some short time after M. Scheiner did the same; in 1611 Fabricius published his observations on the same spots. In 1769 Wilson of Glasgow found a big spot—and further determined that such occur only within 25° on either side of the equator, though they have been seen as far distant as 30°. Probably with more extended observation, they may be found still higher. In 1802 Sir W. Herschel published his celebrated paper on the spots, in which he drew attention to the extra-luminous branching streaks which appear in the neighbourhood of large ones; and stated his conviction that all the phenomena were indicative of violent agitation in the sun's atmosphere: further, he indicated a connection between the prices of English corn and the number of spots. Sir John Herschel has pointed out the analogy which exists between terrestrial cyclones and these solar disturbances. It would almost follow as a matter of course that there were magnetic disturbances also, and General Sabine has shown this to be the case. Many other things are clearly traced to this eccentricity on the part of the sun, and observations are being made all over the world by eminent men, which are being collected and published as "Researches on Solar Physics." That these are interesting no one will doubt who gets hold of those recently issued, and those readers of the observations now before the world will be glad to get hold of the instalments to follow.

When the present writer, twenty years ago, took his first trip to sea, he was informed by the officer of the watch that spots had broken out on the sun, which, observed through a powerful telescope, did not look as if on the sun, but as existing in a kind of fleecy lambswool at a certain distance from the orb of day. It did not strike the observer that they were on or had any connection with the sun; he has since found reason to alter his opinion—not as to spots, for he does not believe that they exist, but that they are an appearance transmitted to the organ of vision. Space will not permit a lengthy demonstration of what is still a crude idea. But a few words may assist in giving an idea to the general reader. Suppose that from a point—and there must be a starting point—there issues flame, and that this point, or sphere, obeying certain laws, is revolving on its own axis while traversing a vortice. This will cause the issuing flame and other exhalation to be ever endeavouring to assume the spiral form—each "spiral" partaking of the quality and form of the whole, acting as an unit in the great body, in its evolution and return, and thus, as it were, causing at one part of the exterior of the formation an immense series of ridge-and-furrow, the light from the depressions being negative, to use a term. Hence it may be inferred that the most exterior sides of the spirals will present that appearance of leafy structure which observers have noticed, and between the "prominences" of light there will also of necessity be what may be termed comparative blackness. Extended research, perhaps a better theory of magnetism than now holds, and a higher class of instruments will assist in elucidating a true "spot" theory: for we feel certain that the present one will have to be abandoned—as has been the case with other theories. Much more, it must be admitted, remains in very crude form, might here be said: another opportunity may be taken to return to the subject. Meanwhile we heartily wish the publishers of the "Researches" all the success that a large sale can bring, and that the study of the matter may produce from our readers some valuable notes.

Vetrical Earthwork Tables. By H. GREENBANK and T. F. PIGOT. London: Vacher and Sons.

These tables for finding the contents of earthworks, &c., when the mètre is the unit of measure employed, are arranged according to the form of the well-known "Bidder Tables." The formulæ used in their calculation are as follow:—

Let a and b = the two terminal heights; then for a length of 20 mètres $\frac{(a+b)}{2} \times 20 = \left\{ \begin{array}{l} \text{central} \\ \text{content,} \end{array} \right.$

$$\frac{(a+b)^2 - ab}{3} \times 20 = \text{slopes.}$$

The lathe is the ordinary formula for the volume of a truncated pyramid with parallel basis. The tables are a credit to the author and to the printer; what has been tested is perfectly correct, and we sincerely wish the enterprising experiment success. They afford the advocates of the system a fine opportunity for "testing" their approval.

Diagrams giving Weights of Iron Girders. By B. BAKER. London: E. and F. N. Spon, Bucklersbury.

On a nicely lithographed sheet we have provided for us clearly illustrative diagrams to scale, giving the weights of girders up to 200ft. span. That they are valuable to the builder, &c., a single look will suffice. Special cases are stated, and a special diagram illustrates them. The merest tyro cannot go wrong in consulting this sheet, and in the making out of estimates, &c., it will prove of much assistance to the busy engineer. The value of the sheet may readily be tested in the usual way; and we are certain that, this once done, Mr. Baker's diagrams will often be brought into requisition.

SUBURBAN VILLAGE AND GENERAL DWELLINGS COMPANY.

We note that the wholesale and reckless demolition of house property by London improvements and new railways has caused a company to start calling itself the Suburban Village and General Dwellings Company. Sir S. Morton Peto, Bart., M.P., is president, and among the directors we find the names of Messrs. John Everitt, Edward Vigers, Carrington Jones, and E. Moore.

The company has been started by the Rev. Jabez Burns, D.D., Dr. Hardwicke, deputy coroner for central Middlesex, Mr. Linnæus Banks, and other gentlemen, for the purpose of providing new dwellings for various classes, but especially the working classes of the metropolis, on sub urban sites. The capital will be £1,000,000 in 100,000 shares of £10 each, with calls limited to £1 in three months. The company propose to purchase estates on which to erect complete suburban villages, with due attention to sanitary laws; to the separation yet association of different classes in one village community; and to facilities for every one to become a purchaser of his own dwelling, on various scales of payment, in the form of rent. An estate of upwards of ten acres within three minutes' walk of the Honor Oak Station of the Chatham and Dover Railway, has already been secured by the directors as the site of their first village, on which operations will be commenced forthwith, and the company are said to have the refusal of one estate capable of yielding 70,000,000 of bricks, with actual advantage to the property as a site for their building purposes. The architects of the company are Messrs. Banks and Barry, and the surveyors Messrs. Leifchild and Cheffins. The temporary offices are at 4, Queen-street-place, Cannon-street West, E.C.

SOLAR CAMERA WORK.

The following is one of the formulas for solar work used in the first-class establishments in France; for sensitiveness and rich tones it cannot be surpassed:—

SALTING SOLUTION.

Water	1 ounce
Chloride of Sodium	18 grains
Fluoride of Ammonia	1 grain
Iodide of potass	1 ,,
Cyanide of potass	1 ,,
Liquor ammonia	2 drops
Gelatine	10 grains

SILVER SOLUTION.

Water	1 ounce
Nitrate of silver	30 grains
Lemon juice	10 drops

DEVELOPER.

Use a saturated solution of gallic acid.

Fix in a weak solution of hyposulph. of soda.

Tone in a weak solution of chloride of gold and uranium, adding about a teaspoonful of bicarbonate of soda.—J. H., in *Humphrey's Journal.*

MEEK'S FASTENINGS, &c., FOR DOORS AND WINDOWS.

A short time since we drew attention to Mr. Meek's invention as one which had been suffered to fall through, though it was evident there were the germs of success in the contents of the provisional specification. We understand that before the first "provisional" expired a second was taken out including various additional improvements, and that now the patent is in full swing, with every probability of being taken up by the building trades. We can only say that such a thing is very much wanted, as we still remain, to a great extent, in the middle ages as regards door and window fastenings. We wish Mr. Meek's invention every success.

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METEOROLOGY.

The Ribbon Storms of North America.

In the last number of the journal *Cosmos*, Dr. Phipson has called attention to those singular tempests known as "Ribbon Storms," one of which was witnessed in all its grandeur by Lord Milton and Dr. Cheadle in their perilous voyage down the Red River. These tempests owe their appellation to the fact that they appear to follow the course of the river, and do not exert their influence to any great distance from either bank; but along the track of the stream their violence is sometimes excessive. The storm witnessed by the authors just named occurred at night; the sky was intensely black, and the tempest began by a vivid flash of lightning, followed immediately by a tremendous clap of thunder, net unlike the explosion of a powder magazine. A strongwind sprung on the river, breaking the branches of the trees on the banks, and accompanied by a deluge of rain. There was from this moment a rapid succession of lightning flashes, and a constant roll of thunder. During the intervals between two flashes of lightning, a feeble blueish light was remarked on the surface of the water, something like the flame of a spirit lamp, or an *ignis fatuus*. This luminous phenomenon, though very distinct in itself, was not strong enough to light up the intense darkness of the night. It was accompanied by a sharp hissing sound, like that produced by the steam which escapes from a machine, and which was louder or weaker according as the light on the surface of the water approached or receded. During all this time the odour of ozone was suffocating.

GLEANINGS FROM SCIENTIFIC WORKS.

Citrate of Quinine and Iron.—Mr. J. C. Braithwaite's inquiries demonstrate the important fact that the ordinary specimens of citrate of quinine and iron contain not unfrequently traces of quinidine.

Carbonic Acid in Venous Blood.—In experimenting with a view to determine the quantity of carbonic acid in venous blood, M. E. F. W. Pflüger has found that the venous fluid of the sheep yields as much as 50 per cent. of this gas. The discrepancies in the estimates of chemists he attributes to the circumstance that the water-vapour was not removed from the receiver of the air-pump used in the investigation.

Impulse of the Heart.—M. Colin contends that the impulsive force of which the left ventricle is capable is four times greater than that of the right. Expressed in pounds, they hold the following ratio—255 : 65.

Improvement in Pattinson's Process for Separating Lead from Silver.—In a factory at Holtzappel they melt the lead in one pot and then run it into a crystallising pan, where they cover the surface with small fragments of coke, upon which a thin stream of water is directed. An agitator being set in movement, a circular motion is given to the mass of metal covered with coke, and thus the entire surface is equally moistened and cooled by the steam of the water. In about an hour the lead loses its fluidity, and forms a solid crust, which envelopes the small pieces of coke. The stream of water is now turned off, the agitator is stopped, and the unsolidified lead, rich in silver, is run off from the bottom. Strong iron hooks are inserted in the mass of lead and coke before complete solidification takes place, and the mass is lifted from the pan by a crane. The pan is then ready for a second operation.—*Polytech. Notizbl.*, 1865, p. 289, and *Bull. de la Soc. Chim.*, Jan. 1866, p. 76.

M. Chevreul has found that although complementary radiations of the spectrum produce *white*, those radiations which emanate from complementary colouring matters, applied in succession or simultaneously to the cloth, &c., afford, according to the proportion, *black*, *brown*, or *grey*. Thus a blue pattern printed on orange will appear black.

Instead of a liquid containing tannin for leather tanning, M. Pfanhausen uses that obtained by heating to redness sulphate of iron, which is kept constantly stirred, dissolving the residue in water, allowing the solution to settle, and then pouring off the clear portion. Weak solutions are used at first, and the process of tanning is completed in a few days.

About 147,070 tons of carbon are calculated to be the annual product of the respiration of the inhabitants of Great Britain and Ireland.

The greatest distance to which a ball from a fire-arm can be projected occurs when the weapon is at an angle of 45 deg. with the horizon.

On confining a taper in a vessel of air until its extinction, the quantity of carbonic acid present was found to be 3·046 per cent.

One volume of water at 32 deg. produces 1,694 volumes of steam at the temperature of 212 deg. Fah., and a pressure of 29·912 inches of mercury.

When animals were removed from a reservoir of air, on becoming comatose, the average amount of carbonic acid present was found to be 10·42 per cent.

In support of the theory of the preservative action of copper against cholera it is affirmed that the great district of copper pyrites of the Riotinto, and its prolongation on the Heulva in Spain, has never been visited by cholera.

It has been ascertained that sheet iron may be protected from oxidation by coating it with a thin fused ayer of magnetic oxide. For this purpose it is embledded in native oxide of iron in a state of powder, and kept at a red heat some hours.

It has been suggested, as a means of indicating the approach of an earthquake, that a magnet should be provided, to which is suspended, by attraction, a little fragment of iron. Shortly before the occurrence of an earthquake the magnet temporarily loses its power, and hence the iron falls.

Mr. Glaisher supposes three feet to be about the mean annual evaporation all over the world. On this assumption the quantity of actual moisture raised in the shape of vapour from the surface of the sea alone amounts to no less than 60,000 cubic miles annually, or nearly 164 miles per day.

The incompressibility of water has been demonstrated by forcing the liquid through the pores of iron three-quarters of an inch in thickness.

It has been stated by Professor Faraday that the total quantity of oxygen daily required for the whole world is 8,000,000,000 lb., or 7,142,857 tons.

The oil of lowest specific gravity known is that obtained from the liver of the sun fish. Great numbers of these fish are taken on the coast of Galway.

Dr. Thomson succeeded in sub-dividing sulphide of lead, so that an atom containing the 1-2,015,000,000,000 of sulphur was visible to the assisted eye.

The attractive force of a magnet being 150 lb. when free from disturbance, fell to one-half by causing an armature to revolve near its poles.

A Magnet, the lifting force of which was 220 lb. when the armature was in contact, sustained 90·6 lb. when the armature was 1-250 in. distant, and 40·5 lb. when 1-50 in. distant. Thus at 1-50th of an inch distance, 4-5ths of the power are lost.

The thickness of a fibre of raw silk subtends the angle of a second at a distance of 8½ feet; a cricket ball, 2½in. in diameter, must be removed in order to subtend the same angle to a distance of 43,000ft., or nearly eight miles. An error of one-thousandth of that angle in calculating the parallax of a fixed star would place that star too far or too near by 200,000,000,000 miles, a space which light requires 118 days to traverse.

M. Saussure's theory that cretinism did not exist in places 1,000 metres, or 3,280 English feet, above the level of the sea, was disproved by the Sardinian Commission, who found numerous cases in localities elevated 1,600 metres, or 5,248ft., above the sea. In one village of this elevation ninety cases of goitre and cretinism were found in every 1,000 of the population.

PHOTOGRAPHIC NOTES.

A Good, Cheap, and Easily Prepared Varnish—Procure some good gum benzoin; place it in an earthenware or metal capsule, and apply moderate heat until it is perfectly fluid. Then pour it upon the bottom of a cold plate, and, when it has been quite cold, it may be broken off in pieces. To form the varnish, the following recipes are good. The second is more expensive than the first, but it is thought a little better:—No. 1. Dissolve in 8 ounces of methylated alcohol 1 ounce of the fused benzoin and 20 grains of sandarac; then add 20 drops of mastic varnish, made by melting gum mastic and adding turpentine to it whilst in a fluid state. The impurities will soon settle, and the varnish is ready for use.

No. 2.	Fused benzoin	½ ounce
	Sandarac	10 grains
	Jalap resin	½ ounce
	Methylated alcohol	8 fluid ounces
	Mastic varnish	20 drops.

Should either of these varnishes be too thick, or become so by use, they may be diluted with a little more spirit. Should the spirit be too strong, which may be known by its partially dissolving the collodion film, a very few drops of water may be added. When using either of the above preparations, the negative may be varnished twice without any danger. This enables us to touch out any spots, &c., on the negative, and then re-varnish, as recommended by Mr. Wilson.

Mode of Fixing.—The fixing solution should consist of 4 ounces of hyposulphite of soda in a pint of water, and should always be used fresh. The number of prints of a given size which may be safely fixed in a definite quantity of hypo solution cannot be absolutely stated. Theoretically, about three parts of hyposulphite of soda will be required to dissolve one of chloride of silver. One whole sheet of sensitive paper has been calculated to contain about from twenty-five to thirty grains of chloride of silver. On this theory about half a dozen sheets of paper might be fixed by one ounce of hyposulphite of soda. In practice, however, so many other circumstances interfere, that perhaps not more than one-fourth of that number ought to be fixed in the quantity. In very cold weather, the solution is comparatively inactive; it is well, therefore, to raise the temperature to about 60° Fah. Thin *Sure* paper will generally be fixed in new hypo, of the strength named, in about ten minutes; thick *Sure* will require fifteen minutes; thin *Rive* paper about fifteen minutes, and thick *Rive* about twenty minutes. A slightly albumenized paper will be fixed more rapidly than a highly albumenized sample; the principle being, that the more horny and resplendent the surface, the longer the time of immersion. Complete immersion and constantly moving about are imperative.—*Year Book of Photography.*

SCIENTIFIC NOTES.

Amyloid Degeneration of the Digestive Tube.—In a paper published in the last volume of the Proceedings of the Société de Biologie M. G. Hayem gives an account of an interesting case of this kind of degeneration. The microscopic examination of the intestinal mucous membrane showed that the deposition of amyloid matter took place in the cellular spaces of the arterioles and in the inner surface of the capillaries. A section made perpendicularly to the surface of the tumefied follicles showed around them a great quantity of altered capillaries, which gave off finer transparent branches that travelled into the interior of the follicle. The follicle itself was filled with small granulations and particles of amyloid matter. The two characters, therefore, which characterise amyloid degeneration of the intestine are: 1, degeneration of the arterioles and capillaries, especially those in the neighbourhood of the follicles; and 2, tumefaction with amyloid degeneration of the follicles themselves.

Nature or Colour-Blindness.—In a very curious essay on this subject, which has been published in "Poggendorff's Annalen," Herr Dr. E. Rose, of Berlin, describes a new instrument for determining the degrees of colour-blinds. From numerous inquiries he concludes:—1. That with the colour-blind it is always light of the greatest or of the least refrangibility that first becomes imperceptible. 2. That invariably, as the disease increases, the patient ceases to perceive only that light which had previously the greatest or smallest refrangibility among the rays visible to him. 3. That colour-blindness is always characterised by a shortening of the spectrum and never by an interruption. A complete and accurately defined spectrum thus forms by its extent a measure of the degree of colour-blindness. Herr Rose's instrument consists of a mirror, condensing lens, and prism, by which a well-marked solar spectrum is produced, and therefore accurately determines the extent of the affection.

The Sun a Body of Ice.—Of all the wild theories which have been invented respecting the nature of the sun, perhaps the most extravagant is contained in "A Treatise on the Sublime Science of Heliography, satisfactorily demonstrating our great Orb of Light, the Sun, to be absolutely no other than a Body of Ice!" by Charles Palmer, gent., London, 1798. The sun is a cold body, says the author, because the temperature decreases as we approach it. Further, a convex lens of glass has the property of collecting all the rays which fall upon it at the focus; a lens of ice has the same effect. For these reasons, he believes that the sun is a huge convex mass of ice, which receives the rays of light and heat proceeding from the Almighty himself, and brings them to a focus upon the earth.

Fossils.—At the last meeting of the Manchester Geological Society, Mr. Wunsch exhibited some vegetable fossils found in a bed of volcanic ash situated near Lagan Bay, in the Isle of Arran. The stone in which the fossils were embedded, appeared like an ordinary piece of whinstone, and fossils in such a stratum were evidently novel. They appeared to be *Sigillaria*, *Lepidodendron*, *Lepidostrobus*, &c., and they had grown in a marine habitat, and had been enveloped with ash from an adjoining volcano. Mr. Plant read a very interesting paper on "The Geology and Fossils of the Primordial Zone in the Gold Districts of North Wales." The locality to which the paper related was in the neighbourhood of Tyddyngwladio, about eight miles north of Dolgelly, and the class of rocks were the lingula, lying above the Cambrians.

RECENT PATENTS.

Improvements in Gas-Engines.—In gas-engines, as at present arranged, it is common to fire the charges of mixed gas and air by means of electricity, but this is inconvenient, as it is found difficult to keep the batteries constantly in working order. Mr. Hugh Smith, of Westbourne Park, therefore proposes as an improvement to fire the charges by means of vapour which burns spontaneously on coming in contact with air; the vapour he employs is that of the liquid phosphide of hydrogen; and he passes small pipes, which he calls explosion tubes, from the gas main to each end of the cylinder, and on these tubes are applied, just before the connection with the cylinder, bottles containing the liquid phosphide, so that the gas may pass over the liquid. When the cylinder is charged with gas and air, a tap on one of the explosion tubes is opened, and the gas, carrying with it the vapour of the phosphide, enters the cylinder, and the vapour there meeting with air, an explosion at once takes place, driving the piston along the cylinder, and in this manner the piston is driven from end to end of the cylinder. This method of firing the charges is applicable whatever be the form of the combustion chamber, whether it be, as assumed in the foregoing description, a cylinder with a piston working within it, or of other form and construction.

Working Puddled Balls or Blooms.—Letters patent have been granted to Mr. William Menelaus, manager of the Dowlais Ironworks, for "improvements in machinery for working puddled balls or blooms of iron and steel," which he thus describes:—"My machinery is mainly intended for working balls or blooms of iron as they come from the puddling furnace or ingot mould; it is composed of three cylindrical rolls made to revolve in the same direction; the two bottom rolls are so placed that the third shall revolve above and in a line between them, and shall have an up and down motion imparted to it by steam or hydraulic power. Though I prefer up and down motion to be imparted to the top roll, yet either of them may be so moved. When the rough bloom or other mass of iron or steel is placed in the machine, the upper roll is raised and is gradually brought down by heavy pressure until the bloom is finished."

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SUBMARINE TELEGRAPHY.*

VI.

LAYING AND REPAIRING CABLES.

Mathematical readers will readily understand that the results are calculable from the data about to be explained:

v = the velocity of the paying-out vessel in feet per second.

v^1 = the velocity of the cable paid out in feet per second.

w = the weight of one foot length of the cable in lbs.

ϕ = the angle which the cable at the surface makes with a horizontal line.

x = the height of any point A from the bottom of the sea.

q = the resistance in lbs. which the water opposes to the motion of each foot of the cable moving perpendicularly to itself, at the speed of one foot per second; q may be called the co-efficient of resistance to displacement.

q^1 = the resistance in lbs. which the water opposes to the motion of each foot of the cable drawn through it lengthways, at the speed of one foot per second; q_1 may be called the co-efficient of friction.

m = the resistance in lbs. which the water opposes to the motion of each foot of the cable moving perpendicularly to itself, at speed of v feet per second; m is assumed $= qv_2$.

m_1 = the resistance in lbs. which the water opposes to the motion of each foot of the cable drawn through it lengthwise at the speed v. m^1 is assumed $= q_1 v_2$.

t = tension in lbs. at point A, which in what follows will be assumed as at the surface where the maximum strain occurs.

Then if the cable be laid without any tension at the bottom, which is now invariably done, the equation to the curve assumed by the cable will become the equation to a straight line inclined at an angle to the horizon such that

$$(1.)\ \text{Cos.}\ \phi = \frac{\sqrt{w^2 + 4m_2} - w}{2m}$$

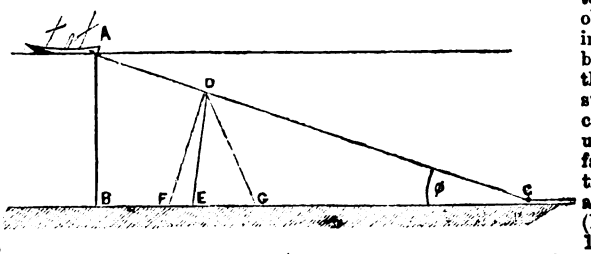
Or, what amounts to the same,

$$(2.)\ \frac{\text{Cos.}\ \phi}{\text{Sin.}^2\ \phi} = \frac{qv^2}{w}.$$

From this it appears that the angle at which any given cable will be paid out is (when not tight at bottom), independent of the tension t (or of the velocity v^1), and is dependent simply on the velocity v of the ship. Cables which are bulky for their weight, or, in other words, are of light specific gravity, lie at a small angle, but by increasing the ship's speed any cable may be paid out at a small angle. We find further, when no slack is paid out,

$$(3.)\ t = \left(w - m^1 \frac{(1 - \text{cos.}\ \phi)^2}{\text{Sin.}\ \phi}\right) x$$

$w\,x$ is simply the weight of a length of the cable hanging plumb from the ship to the bottom. This is the maximum tension that can be required to lay any cable without slack. The tension is always slightly diminished by a certain small portion of its amount constant, for a given speed and cable. The annexed diagram may help to explain the results arrived at. The cable A C, lying on an inclined plane of water at the angle ϕ, is carried by a tension equal to the weight of a length A B of cable, somewhat as a chain would be in equilibrium lying on a frictionless inclined plane A C, and hanging down over a pulley at A to the depth B; but the inclined plane of water is not at rest, it yields under the cable at every instant at every spot; if the cable were pressed through the water in a direction perpendicular to itself, so that the plane of water yielded before the pressure of the cable, and did not slip along it at all, the above analogy would be perfect, and the tension at A would be simply equal to $w\,x$; but since we have supposed the cable to be laid without tension, and without slack at the bottom, any point D must finally come to a point E, such that E C = D C; and it will be easily seen that the point D to do this must move in a straight line E D. Now this line D E is not perpendicular to A C; it falls within that perpendicular D F, so that if we suppose the plane of water under A C to fall perpendicularly before it, we must also conceive the cable as slipping back a little on the plane by an amount corresponding to the space between D F and D E, but this slip is opposed by the friction of the water, which thus tends to prevent the cable from running back on the incline and plane, and so relieves the tension by a small amount. This amount is so small that it may be practically neglected, and would not have been mentioned did not the same considerations enable us to understand the effect of laying cable with a certain amount of slack. When this is done a point, D, moves in a line, say D G, differing much more in direction from D F than D E does. When much slack is laid, the cable slips back at a considerable velocity on the inclined plane, and meets with a frictional resistance tending considerably to relieve the tension. Thus, when the cable is paid out at a velocity v^1, we have



$$(4.)\ t = \left[\frac{w - m^1 \dfrac{\left(\dfrac{v_1}{v} - \text{cos.}\ \phi\right)^2}{\text{sin.}\ \phi}}{}\right] x$$

When v^1 is considerably in excess of v, the fraction of the whole tension which the friction m^1 subtracts from $w\,x$ is very considerable. It also increases rapidly as the speed of the ship increases, and it further increases if the specific gravity of the cable be small, for then it lies at great length in the water, presenting an immense surface to be gripped by the water. The friction on each foot is but small, but when twelve or thirteen miles of cable lie in the water, presenting a surface of 70,000 or 80,000 square feet, the result is practically very important. Assuming a mean speed of 10·4 feet per second as that at which the Atlantic cable was paid out when lying at an angle of 9° 30′ in 2,000 fathoms of water, with a tension of 12 cwt., we obtain the following values for the constants:—

$q = 0{\cdot}085 = 0{\cdot}81\ D$ } where D = diameter
$q^1 = 0{\cdot}0085 = 0{\cdot}081\ D$ } of cable in feet.

From some observations it would seem as if the angle had been even less than the above, in which case q would be larger and q^1 smaller. From Beaufoy's experiments we should have expected q to be more nearly 0·65 D; but the roughness of the cable may account for the difference, as it certainly does for the great difference in the co-efficient of friction, which is nearly eight times that which a smooth surface would present. It is probable that for a smooth iron cable the value of q^1 would be more nearly equal to 0·001 D, and $q = 0{\cdot}065$ D. One reason will now be plain for giving in the foregoing tables the strength of the various cables relatively to the depth in which they are to be laid. The strain required to lay them is always a fraction of that depth, but the strain will not be always the same fraction of the depth, but will be smaller for the lighter cables when laid slack.

4. *Application of Theory.*—The practical results of equation (4) are most important. To lay any cable, however light, quite taut, we require nearly the tension due to a weight of the cable hanging plumb from the surface to the bottom; but by increasing the bulk of any cable, though we do not diminish its actual weight, we may, by laying a little slack, diminish the tension very greatly. With such a cable as the second Atlantic the tension was thus diminished more than half; to lay it taut would have required nearly 28cwt., and 12cwt. was the amount actually required when about 15 per cent. slack was paid out. The strain could be maintained constant in all depths, by allowing a little more slack to run out in deep water, and even this could be prevented by a slight increase in the speed of the ship. No relief at all comparable to the above is obtained by paying out heavy cables slack; but, on the other hand, still lighter cables can be paid out under still more favourable conditions. The ratan and hemp cable (No. 11, Appendix 1) would, with 12 per cent. slack, be paid out without any strain at all, and if more slack than this were desired the cable would have to be pushed out of the ship. Nearly the same might be said of a bare gutta-percha wire. The Atlantic cable, in the last expedition, was laid in depths varying from 1,750 to 2,000 fathoms, at speeds for the ship varying from 4¾ to 6¾ knots per hour, while the cable ran out at from 5 to nearly 8 knots per hour. The angle, according to one method of observation, varied from 9° to nearly 12°, but was somewhat less according to other observations; 9° 30′ seems to have been a usual angle. The slack paid out in deep water ranged from 9 per cent. to about 18½ per cent. On the last day the slack was about 14·8 per cent. The strain on the cable was very constant, ranging from 10cwt. to 14cwt., and generally being between 11cwt. and 13cwt.; the pitching of the ship never caused more than about 2cwt. difference in the strain; but once, when going slow to change holds, the strain was 17cwt.; this accords with theory. The lecturer has to thank the engineers of the Telegraph Construction and Maintenance Company for the above information.

5. *Proposed Improvements.*—Reels have been proposed in ships as a substitute for the coils in tanks. Their great mass in motion would be difficult to control. Mr. Siemens actually tried with some success a reel for a light cable, and drove it with an engine; he abandoned the plan for the old system. The defects which the reel is supposed to remedy do not exist. Captain Selwyn has proposed to use a reel floating in the sea, ingeniously retarded by paddles, which would prevent too much slack from being laid. It hardly becomes a landsman to tell a sailor that such a reel would be unmanageable; but the difficulties of coiling in water, of launching the reel if coiled on land, of protecting the surface of the cable against collisions, of testing the cable, of remedying any defect, should any arise, and even of preventing one coil from cutting into those immediately below it, seem unavoidable, and the defects the invention is supposed to remedy are imaginary. Buoys have been proposed to relieve the cable from part of its weight; any hollow buoys would be crushed very shortly after leaving the surface. Mere wooden floats would do little, and be difficult of attachment. This invention also labours under the disadvantage of being unnecessary, since cables can be paid out with 12 cwt. strain or less, which will bear 150 cwt. Vanes on a cable, opposing its slipping backwards, would be correct in principle, although probably quite impracticable; the result aimed at is obtained by increasing and roughening the surface of the cable. Most engineers who have had practical experience deprecate any attempt to catch the cable by nippers after it has left the ship. The danger of fouling is more considerable than the extra chance of safety given by the nipper. Lastly, many proposals have been made for some kind of elastic arrangement, to compensate for the change of strain caused by the rise and fall of the ship. When cables are paid out so nearly horizontally as is now the case, these arrangements, even if practicable, are not required; the alteration of the strain, caused by the motion of the ship, is quite inconsiderable, and there is great difficulty in devising any elastic arrangement which, by the

* Lecture III.—Read by FLEEMING JENKIN, Esq., C.E., F.R.S., at the meeting of the Society of Arts, February 5.

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inertia or momentum of its parts, would not aggravate the evil, such as it is. Unless when going very slow, in very bad weather, the best conceivable elastic arrangement would be useless, if not injurious.

AN INEXPENSIVE EQUATORIAL STAND.*

Sir,—As some of your readers may consider an equatorial stand a rather expensive luxury, and, in consequence, put up with a much less convenient form of mounting, I will describe one I contrived about two years ago, and which I have had in use ever since, with perfect satisfaction as to steadiness and general convenience. It can be made by any amateur who can handle a saw and screw-driver for a few shillings, and he may have the luxury of a mechanical motion which will keep his telescope upon a star as long as he wishes to look at it.

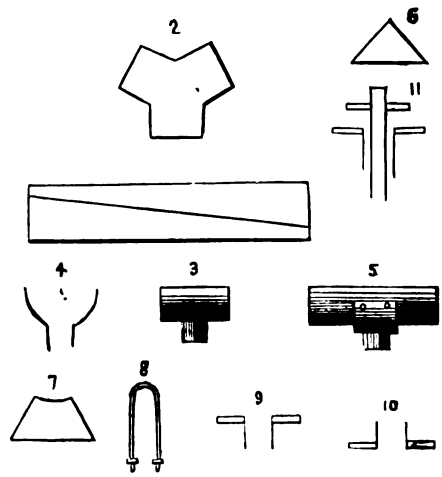
PHILIP VALLANCE.

Three strong legs are necessary for the stand, and these may be most cheaply made by getting a 14-foot length of 2-inch yellow deal, and having cross-cut it in the middle, then sawing each half with a diagonal cut, beginning at 2 inches from the outside of one end and ending at 2 inches of the outside of the other end as in fig 1. This will make four legs 7 inches wide at one end, 2 inches wide at the other, and 2 inches thick. There will also be one more leg than is wanted, but as the labour in doing this is but little, I know of no cheaper way of getting three strong legs.

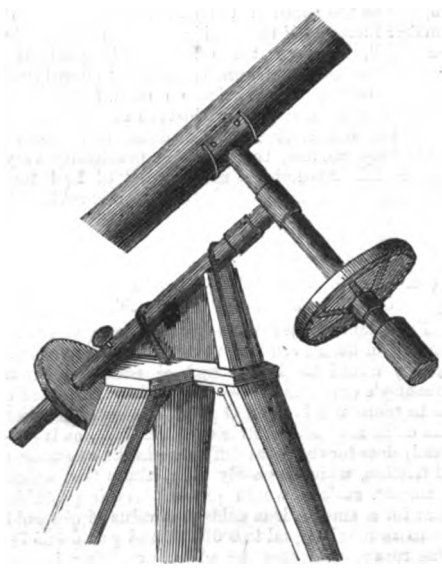
The top of the stand is to be made of beech 1½-inch thick. Cut a circle of 18 inches diameter, and on the circumference set out three points equi-distant, and 3½ inches from these points on each side of them, cut out a piece as in fig. 2; this will leave three projections, 7 inches wide, for the legs to be fixed to. On each of these projections one leg is to be fastend by a large door hinge, at least 6 inches long—having previously cut each leg to the right bevil at the top and bottom, and of the right length in accordance with the length of the telescope to be used. The legs of my stand are 5 feet 7 inches long, and spread 2 feet 6 inches from their common centre; and the length of my telescope is 80 inches, and its aperture 5½ inches. So much for the stand.

The parts to carry the telescope are to be made of iron gas tubing, and are as follow: A two-foot length of 2-inch iron gas tube (called by gas fitters a *short-piece*) is to be cut asunder 8 inches from one end, and 2 two-foot lengths (or short pieces) of 1½-inch iron gas tube, are to be selected small enough to turn easily inside the 2-inch pieces. This will require a little attention, as all 2-inch tube is not large enough for 1½-inch to turn inside it, but plenty may be got with a little trouble; therefore it is best to get one length of 2-inch and cut it asunder, instead of getting two short pieces of the requisite length. (Each short-piece has a screw on each end, and a socket-piece, on one of these screws.

Two T pieces are next to be got, having an opening to receive the 1½-inch tube at the bottom or middle, and opening to receive the 2-inch tube at the ends or sides; see fig. 3. These will be screwed one on to the end of each of the 1½-inch short-pieces—one to form the polar axis and to carry the tube of the declination axis, and the other to hold the cradle of the telescope, for which it must be cut open lengthways on the top and bent into the shape to fit the cradle as in fig. 4; on this must be riveted a cradle of sheet iron or brass to carry the telescope, as in fig. 5. The 16-inch length of the 2-inch short-pieces, having the socket on its top, is to carry the polar axis, and must be fixed on the top of the stand at an angle of 51½ degrees, or the latitude of the place with the upper end over the centre of one of the legs of the stand and the lower end between the two others, by two pieces of beech 1½-inch thick, and shaped as in figs. 6 and 7; the last (No. 7) to stand across the polar axis and over the leg of the stand, and the other (No. 6) lengthways with the poplar axis, to support it on the top of the stand. Each of these pieces should be hollowed out to fit the tube that



lies upon it, and the tube should be fastened to these pieces, and these pieces to the stand by two pieces of ⅜ iron wire, bent as in fig 8, and having screws and nuts on each end, one at the top, over the tube, close under the socket of the 16-inch length, outside the piece No. 7 and down through the top of the stand; and the other near the bottom of the tube, across it and the piece of wood carrying it, down through the top of the stand; and fixed by the nuts and screws.



The tube which carries the polar axis being thus firmly fixed on the stand, one of the lengths of the 1½-inch tube, having the T piece on its top, is to be passed through it; then into this T piece is to be screwed the other length of the 2-inch tube, and through that is to be put the length of the 1½-inch tube on which is screwed the T piece carrying the cradle for the telescope.

You have thus, at the cost of a few shillings, an equatorial stand, perfectly steady, capable of pointing the telescope in every direction, and, if properly placed, of following a star with one motion.

The telescope and cradle, &c., must be balanced by a counterpoise put on the end of the declination axis; and the telescope placed in the cradle with its centre of gravity over the centre of its axis.

The method I have adopted for giving motion to the telescope is as follows: On the polar axis, at the end which is below the stand, and at a right angle to it, I have a lever fixed by a binding screw, which, when tight, carries the polar axis with it, and when loose allows the polar axis to turn without it.

This lever stands out from the polar axis and between the east and west legs of the stand. On the eastern leg I have a pulley, and a line fastened to the lever running through this pulley has a weight on it capable of pulling the telescope after a star that is towards the west. To regulate the speed of the telescope I place a bladder of air between the lever and the leg of the stand, having a tube from it with a stop-cock; of course, the faster the air gets out the faster the telescope moves, and I regulate the speed most readily by putting the end of the cock into a little water, when, as the bubbles of air are heard to come out, the speed can be regulated to the greatest nicety.

Two round discs of wood, having their surfaces hollowed out to something like the curve of the bladder, are placed, one between the lever and the bladder, and the other between the bladder and the leg of the stand, each being attached (the one to the lever and the other to the leg of the stand) by a loose pin in its centre long enough to allow them to press the bladder squarely between them. I make a hole lengthways through the centre of each pin, and a corresponding hole through the centre of the disc of wood and of the lever or leg, and a piece of cord, with a knot at each end, holds the disc of wood so loosely against the bladder as for it to press squarely, although the lever and leg form a constantly varying angle.

In the tube through which the air passes out of the bladder into the water is an extra stop-cock, to shut off or turn on the air as required, so that the regulating cock need not be touched after being once adjusted. A second tube also goes into the bladder to blow more air in when it is exhausted.

By this simple contrivance I have kept a star in the field of my telescope for three quarters of an hour, and it would do so longer but that the discs of wood approach so near that the surface of the bladder is increased, and the speed lessened by that.

By taking a little more trouble, and also going to a little more expense in the getting up of the stand, a very tolerable equatorial may be made, quite capable of pointing the telescope on any star, by the tables, clock, and almanac.

First—In the socket of the 2-inch tubes which carries the polar axis, have a brass bearing, made with a flange, as in fig. 9; and also on the other end of the same 2-inch tube fix a similar flanged socket as in fig. 10. The 1½-inch tube which goes through it must be turned at the parts where it bears on each of the brasses, and also have fixed on it, at each end, another brass-flanged socket, to bear smoothly against the other flanges, as in fig. 11. This will give perfect smoothness to the motion.

And on the other 2-inch tube, which carries the declination axis, fix similar brasses, and turn the 1½-inch tube in the same manner.

For the circles and indices I have made use of old theodolite circles, and have fixed them on discs of mahogany screwed tight on to the flanges of the large tubes; and the indexes to the other flanges carried by the smaller tubes.

The telescope must be set true to the polar axis, and at right angles to the declination axis, by packing in the cradle which carries it.

In conclusion, I may state that I have had a 10-foot refractor with a 7-inch aperture on a stand of this size and construction, which has been perfectly steady and easy in all its movements.

A stand of yet more easy construction may be made by using similar tubing in this manner:—

Fix what is here called the polar axis tube upright on the top of the stand; and the other tubes being placed as before described, a stand of the altitude and azimuth class will be the result, which, by using the tubes rough as they come from the

* Extracted from the *Astronomical Register* for February. Published by J. D. Potter, 31, Poultry.

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shops, will be easily made, and yet be found steady and convenient.

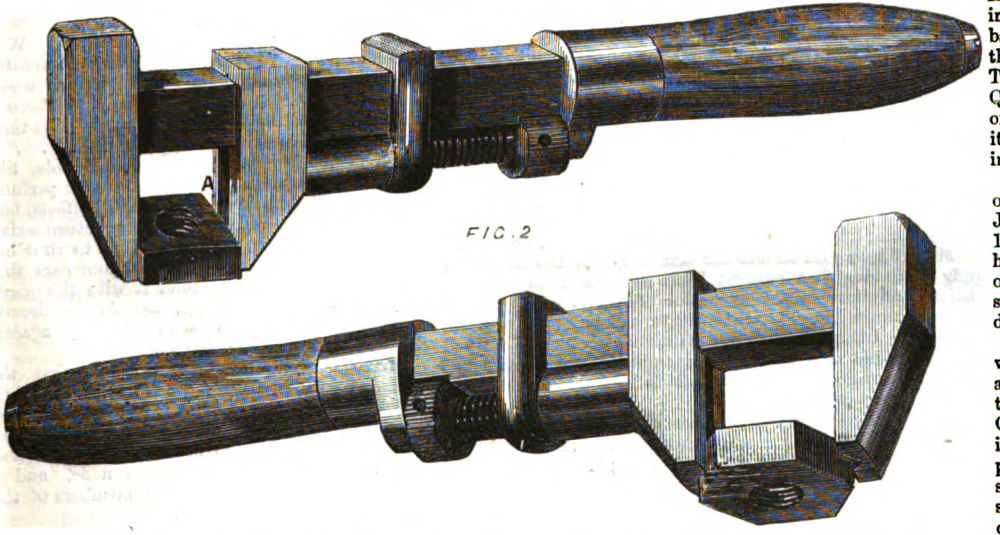
A clamping screw should be put in each of the 2-inch tubes, which, by pressing on the interior tube, will fix it at any point, or prevent it from turning too easily.

For smaller telescopes smaller tubes may be used. I have one for a 4¼-inch, 6-foot focus, made of 1½-inch and 1-inch tubes; and another for a 3¾-inch, and a 4-foot focus, made with 1-inch and ¾-inch tubes.

IMPROVED AMERICAN SCREW WRENCH.

Any one who has occasion to use a screw wrench must have noticed that in many cases it is impossible to turn the nut more than one square, by reason of some part interfering with the handle or the head of the wrench. At such times it is common for careless persons to use the head of the wrench as a hammer and knock the nut around until they can get a turn on it again. It is needless to say that this is a most reprehensible practice, as it injures the nut and the wrench, besides being a waste of time.

FIG. 1.



The wrench shown herewith is simple and useful. It is nothing more than a V-shaped groove, A, made in the jaws of the wrench, so that they will fit over the corners of the nut and turn it, as shown in the engraving.

The groove does not in any way affect the strength of the wrench, and the tool is indispensable about locomotives, marine engines, agricultural machines, and printing presses; in short, all mechanism which is necessarily compact. The groove is of such a form that it does not touch the sharp edge, but the sides contiguous to it. For use on mowing machines, reapers, and general farm purposes, it will be found a great advantage. It is now much in use in the machine shops in the U nited States.

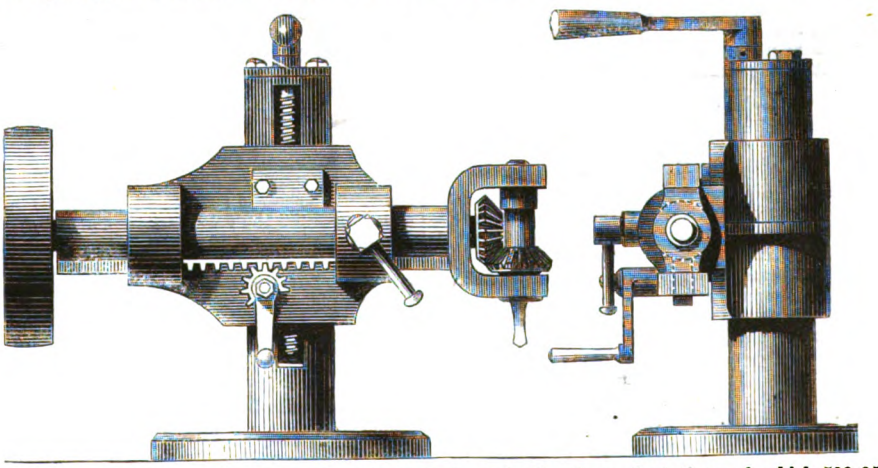
By the addition of the hole in the milled head of the screw, a nail or any small rod can be used to set the jaws up very tight, so that the wrench can be employed as a hand vice, or to screw up round bolts. The back of the jaw is made rounding to secure additional strength.

TYRE DRILLING MACHINE.

The accompanying figures show a side and end elevation of a machine employed at the works of the Great Eastern Railway Company, at Stratford, for drilling the bolt holes in wheel tyres. In some modes of fastening the tyres, the bolts are screwed in from the inner side of the rim of the wheel, the hole for the bolt not extending through the tyre, and in such cases the ordinary drilling machine cannot, of course, be employed.

In the machine shown by our illustration, the drill spindle is made so short that it can pass into the space between the boss and rim of a 3 ft. 6 in. wheel, and it is carried at the end of a sliding arm, by which its distance from the main pillar of the machine can be varied. The pair of wheels to be drilled are rested upon a couple of pairs of small friction wheels, fixed at the proper distance apart on one side of the machine. The wheels having been adjusted, the arm of the machine carrying the drill spindle is slid out so that the drill is brought over the proper point in the wheel rim, between the lowest pair of spokes. After the hole has been drilled, the arm is withdrawn and the wheels turned round upon the friction wheels, so as to bring another part of the rim in a line with the drill spindle, when the arm is again slid out and another hole drilled, and so on.

The motion is communicated to the drill, through a pair of bevel wheels, one of which is fixed on the drill spindle, and the other on a shaft passing through the sliding arm and carrying at its other end a belt pulley. From this pulley a belt extends to another fixed upon a counter shaft, this last pulley being broad enough to allow of the strap traversing backwards and forwards upon it, and so adjusting itself to the various positions of the pulley carried by the shaft passing through the sliding arm. The arm carrying the drill is slid inwards or outwards, by meane of a pinion gearing into a rack on the under side of the arm. The carriage through which the sliding arm passes is capable of traversing vertically upon the main pillar of the machine, its position being regulated by a screw contained in this pillar, and furnished with a handle at the top. By means of this screw the carriage can be raised or lowered, and the required "feed" can thus be given to the drill.—*Engineering.*



THE CULTIVATION OF QUININE.*

The cultivation of Quinine in Java and British India has been treated of lately by Dr. J. E. De Vrij. The Quinine-yielding trees grow at various heights above the level of the sea in the primitive forests of the contiguous requblics of Venezuela, New Grenada, the Ecuador, Peru, and Bolivia. The medicinal properties of the trees have been known from time immemorial to the natives of those countries, but it was not until 1632, that the curative powers of Quinine were known in Europe. The cure effected by the remedy in the Countess de Chinchon, wife of the Viceroy of Peru, brought it into greater notice. The trees were included by Linnæus, in the Genus Cinchona, or, as Dr. De Vrij and others call it, Chinchona. Various species of Cinchona yield the febrifugal alkaloids, Quinine, Cinchonine (Chinchonine), Quinidine, and Cinchonidine. Of these Quinine is the most powerful, and hence the most valued. The species which yields it in largest quantity, is Cinchona Calisaya. Great apprehensions were entertained recently that the trees in South America would ultimately become extinct in consequence of being stripped of their bark, and no means being taken to replace the trees which were felled for decortication. The Dutch Government introduced the Quinine trees into Batavia in 1852. The original plant died, but two slips taken from it to Buitenzorg, continued to thrive, and in 1862 acquired a height of 20 feet.

M. Hasskarl was appointed to take charge of collecting Quinine plants and seeds for Java. He landed at Batavia on Dec. 13th, 1854, with 21 chests of Quinine plants, and he was entrusted with the management of the plantations. In 1856, he was succeeded by M. F. W. Junghuhn, who died in 1864.

Besides the true Calisaya bark, there were several other species cultivated and among them a new species which received the name of Cinchona Pahudiana, after M. Charles F. Pahud, Minister of the Colonies, in the Netherlands. The plants were at first propagated by seeds and the process was slow, but Mr. McIvor, at Ootacamund, subsequently ascertained that the plants could be much more rapidly and extensively propagated by slips, and this led to a rapid increase. When M. Junghuhn undertook the management in July, 1856, there were 521 living plants, 1,650 slips; but at the end of December, 1863, there were 1,151,810 Quinine plants in the Java plantations, of which 539,050 were growing in the open air, and 612,771 in the sprouting beds and nurseries, besides nearly 7,000 live slips. The plants consisted of:—

Cinchona	Calisaya	12,090
,,	lancifolia	251
,,	succirubra	89
,,	lanceolata	128
,,	micrantha	1
,,	Pahudiana	1,139,248

* "On the Cultivation of Quinine in Java and British India." By Dr. J. E. De Vrij, late Superintendent of Chemical Researches in Dutch India. London, 1865.

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These were distributed in plantations varying from 4,440 to 6,830 feet above the level of the sea.

In 1855 an unsuccessful attempt was made to introduce the Quinine trees into British India. In 1859, Mr. Clements R. Markham proceeded to South America in order to procure plants for India. The plants transmitted by him to Ootacamund died, but he made arrangements for the transmission of plants and seeds, which have now been successfully cultivated at Darjeeling, at the foot of the Himalaya; at Hakgalle, near Newera Ellia, in Ceylon; and at Ootacamund, in the Neilgherries. The Darjeeling plantation is under the charge of Dr. Thomas Anderson, superintendent of the Botanic Garden at Calcutta, and in 1864 it contained about 20,000 plants. The Ceylon plantation, 5,200 feet above the level of the sea, is managed by Mr. McNicoll, under the superintendence of Mr. G. H. K. Thwaites, Director of the Botanic Garden at Peradenia. At the end of 1863 this plantation contained 22,050 Quinine plants. The plantation at Ootacamund, 7,500 feet above the level of the sea, as well as a branch one at Neddiwuttum, is superintended by Mr. McIvor, who has done much by his mode of cultivation to promote the increase of the trees in India. In 1861 there were 172 young plants at Ootacamund, and in 1863 they had increased to 277,083. They were chiefly C. succirubra, or the red bark. An important improvement in Cinchona cultivation, introduced by Mr. McIvor, was planting the trees on fully-exposed open spots, and not under the shade of other trees. The woods were cleared away in the first instance, and then the Cinchonas were planted. The effect of exposure to the sun is the production of Quinine in larger quantity, as might have been expected. Mr. McIvor finds that the young branches supply a bark which yields Quinine. He expects before the end of December, 1865, to forward to Europe between 3,000 and 4,200 lbs. weight of Quinine bark, the yield of 16,000 plants set at Neddiwuttum in September, October, and November, 1862. Dr. De Vrij concludes by giving the following contrast between the Dutch and the English mode of cultivation:—"As the Quinine trees in Java must, according to the present mode of cultivation adopted in that island, be at least thirty years old before they are fully capable of yielding a good quality of bark, I very much doubt whether any capitalists would be found willing to employ their capital in that way for so long a period, and I feel bound, therefore, to answer the question in the negative. The English system, on the other hand, which admits of good interest on capital within four years at the most, and which continues regularly progressing in that respect, is certainly one which prepares the way for the transfer, in due course of time, of the cultivation to private industry."

THE OCCULT SCIENCES AND ANIMAL MAGNETISM.—II.

By M. Bauche.

In spite of the reprobation with which the practice of divination has ever been denounced, we count not less than from seventy-five to eighty branches of it.

That persons, otherwise very estimable, believe in these pretended sciences should neither astonise nor trouble us; they are as much and more to be pitied than blamed, especially if they pay the oracles they go to consult in ready cash, and wh see that they only have the difficulty of making a choice. . . . .

I read lately a feuilleton signed M. Oscar Commettant, on the subject of the Brothers Davenport, from which I extract the following lines:—

"At all epochs men have shown themselves greedy for the marvellous, and fairy tales are of all ages. There are moral pests as there are physical pests, and spiritualism is the very oïdium of our brain; the moral fungus which attaches itself to our reason. The history of the world is the history of folly and credulity, from the mysteries of Isis to the miracles of . . . . our nineteenth century.

"Almost all men who were reputed right thinking in antiquity believed in magic, in theurgy, in witches, &c. Cæsar believed in sacred chickens, and followed out his projects or renounced them according to the manner in which he saw them peck the grain which he threw to them. . . . . For several ages the world believed in sorcerers and burned about three hundred thousand of them . . . .

". . . . Pascal believed in ghosts; Charles V. (says Le Sage) so thoroughly believed that the future of men was written in the sky, that he instituted, with the approbation of the clergy, the nobility and the magistracy, *a special college where the occult sciences were taught.*

"Henry IV. and Anne of Austria had the horoscopes of Louis XIII. and Louis XIV. cast. Richelieu and Mazarin, both of them cardinals and ministers, sincerely believed in witchcraft, and treated as materialists those who did not believe in it . . . . Under Louis XV. the Count of Saint Germain was the rage, and every one was persuaded that this adroit supernatural swindler had been in the world for eighteen hundred years, and that he had been intimate with Charles V., Francis I., Nostradamus, Attila, &c.

"Is it necessary," adds the witty feuilletonist, "to recall the success of Cagliostro and later those of Mesmer and his magical banquet?"

I stop at this point of my quotation, where, *à propos* of spiritualism, which is tolerably rudely treated in it, and which is big enough to defend itself single handed, if it likes, against accusations of relationship with necromancy, we see come on, by gradation, animal magnetism personified in him who did not invent but resuscitate it—who, as I have said on another occasion, has the merit of having first brought back to natural and purely physical causes an order of phenomena, which before him was attributed to extra-natural causes.

I have endeavoured to sketch the picture of the occult sciences in bold lines, it remains for me to enunciate briefly what is animal or human magnetism.

I will suppose that I am speaking before persons who have no knowledge whatever of it.

Its definitions are numerous; I will cite two only. Here is the first:—

"Animal magnetism consists in certain effects which a man makes another man experience; in other words, the word magnetism signifies the ensemble of the phenomena resulting from the *incontestable influence* which every animated being may exercise over its like.

"Magnetic science has for its object the useful application of this influence."

Let us see the second definition:—

"By animal magnetism is understood the reciprocal influence which sometimes operates between individuals, *according to a harmony of affinity*, be it through the will or the imagination, or be it from imitation or the concurrence of physical sensibility."

This definition, you see, is broad and does not much compromise its author.

It gives a show of right to all the doctrines, and equally satisfies the volontiste, the imaginationists, the imitationists and the fluidists.

By well observing the facts, by studying, without prejudice, the different systems, and at the same time the phenomena which take place in the application of magnetism, we have reason for believing that this definition is one of the best, for, in this question, we have to keep within a prudent eclecticism.]

Whatever may be the first cause of the magnetic phenomena, do these phenomena take place or do they not?

Denial is inadmissible. Now, if a series of material facts, of physical phenomena which have for their basis a natural principle, constitutes the elements not only of a science, but further of a science as exact as possible outside of the mathematics, we cannot deny a scientific character to what is called, improperly perhaps, animal magnetism.

Is this science the privilege of the minority to the exclusion of the greater number? We affirm that it is the domain of all, as we lay it down as a principle that the influence of animated beings on their likes is reciprocal. Are any mysterious initiatory ceremonies necessary for being admitted to penetrate the arcana of magnetic science? No. We require only a certificate of morality.

Our conjuring-book is not the book of the secrets of the great Albert, it is the *Practical Instruction* of the venerable Deleuze, or more than that, the works of that old master whom we love and respect still less perhaps than he merits, of that indefatigable champion who, forty-five years ago, planted the banner of magnetism before the academies, and has ceased not to combat in its defence with that persisting energy which faith in the justice of a cause can alone inspire and sustain: my words indicate M. le Baron du Potet.

Have the most transcendant phenomena which we see succeed one another anything of the supernatural or the extra-natural? No, a hundred times no! Only we know not precisely the cause, or, to better express it, those who have studied magnetism and to whom its existence is no longer a subject of doubt, do not agree as to this first cause.

What of that, after all?

Do we know why opium causes sleep? Why an emetic causes vomiting? *Quia habent virtutem dormitivum et vomitivum*, a physician would answer . . . . in the time of Molière (I speak not of to day), but how many *becauses* there are which have nothing more in them. . . .

The magnetic agent is an imponderable, like calorie, like electricity, like light, like the perfume of flowers; it can be grasped only in its effects, but, whatever may be its principle, magnetism exists and is self asserting. To deny it is to shut our eyes that we may not see, to stop our ears that we may not hear; to confound it with the occult sciences such as the cabala, astrology, sorcery, necromancy, and others is an absurdity against which we cannot cry out too loudly.

I have very summarily enunciated what the pretended occult sciences consist in, I have just told in all its simplicity what animal magnetism is, and I ask, can anyone, honestly, find any link whatever of relationship between the latter and former. For myself I recognise none, and I repudiate all connection with all members of the more or less diabolical family.

Of magnetism a member of the Royal Academy of Medicine has not feared to say, that, "considered as an agent of *psychological* phenomena, or as a therapeutic agent, magnetism should take its place in the rank of medical sciences." He who thus expressed himself, after a long and conscientious examination of animal magnetism, was Dr. Husson, and those who signed the report were no less than Drs. Bourdois de la Motte, Fouquier, Guéneau de Mussy, Guersant, J. J. Leroux, Marc, and Thillaie.

I would reply to an observation concerning somnambulism and somnambulic consultations, which are not the same things.

Let it first be thoroughly understood that *magnetism* and somnambulism are not synonymes. The first is the cause, the second the effect, or rather magnetism only develops the somnambulic faculties in persons who are naturally endowed with them. We can no more make a somnambulist at will, and especially a good somnambulist, than we can make a poet, an orator, or a true artist.

But this state of artificial somnambulism, extraordinary as it is, is nothing, so to speak, if it is not accompanied by that marvellous faculty to which the name of clairvoyance has been given.

Does this lucidity exist? Yes, but it is capricious, inconstant, and it does not depend more upon the most skilful magnetiser for its creation than for its regulation, and for the preventing of its vagaries.

Magnetising and lulling asleep are *not* one and the same thing; that somnambulism is a state; that being brought into the somnambulic state does not imply the gift of clairvoyance; that the lucid subjects are only so on certain days and at certain moments; that they almost all have special aptitudes, and that their errors are excessively frequent.

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Therefore is it not risking a paradox to pretend that the discovery, and consequently the employment, of somnambulism, thanks to the too often shameful use that has been made of it, has rather clogged than advanced the march of magnetism? for *there only is the source of that assimilation* which I am endeavouring to combat, and from this point of view those who have done the greatest wrong to the science of Mesmer are the magnetisers.

Let us believe in somnambulism; let us believe in lucidity; but let us not have a blind faith in the declarations of somnambulists, even of the true ones.

To conclude, there is nothing in common between the *sciences called occult*, which we might very justly call *chimerical*, and true *magnetism*, as I understand it, and as it is taught and practised in this society.

To be convinced of this truth it suffices to study the one, to know what were or what are the others, and the confusion which has existed, and which still exists, will not be long in vanishing awae, for mere good sense will speedily pronouncy judgment between them. A. BAUCHE.

L'Union Magnétique, Dec. 10, 1865.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

EQUATORIAL MOUNTING FOR A REFLECTOR.

Sir,—I feel that I owe a very sincere apology for having made a promise to T. W. B. which I am unable to fulfil. I refer to that which I gave in No. 45 of the ENGLISH MECHANIC, p. 258, to go up to London and copy the drawing and description of Mr. Lassell's equatorial, and also that of Mr. de la Rue, which I then believed to be at the apartments of the Astronomical Society at Somerset House. I have been up, and, in attempted redemption of my promise, applied for these drawings and descriptions. I regret, unaffectedly, to say that none such exist. I remembered seeing Mr. Lassell's photograph of his large telescope, and am now informed that this photograph (unaccompanied by any description whatever) is all that the society possesses; and further that Mr. de la Rue has never given any details of his equatorial mounting for a reflector at all. I cannot conceive by what perversion of my memory I seemed to recollect having seen the particulars of these instruments. Under any circumstances, my quasi-reminiscences turn out to have been purely imaginary; and nothing more remains for me than to express my sincere sorrow that I should have misled T. W. B., however unintentionally, on this subject.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

RENOVATING FILES.

Sir,—I have tried the following receipt with success and think many readers will find it worth knowing.

The file to be first cleansed from all foreign matter, and then dipped in 1 part of nitric acid, 3 parts of sulphuric acid, and 7 parts of water, the time of immersion will be according to the extent the file has been worn and the fineness of the teeth, varying from five seconds to five minutes; on taking it out of the mixture, wash in water, then dip in milk of lime, and then wash off the lime, dry by a gentle heat and rub over equal parts of olive oil and turpentine, and finally brush over with powdered coke. It is stated that a new file is improved by a few seconds' immersion, and also that rasps may be renovated in the same way; this I have not tried, but for fine cut files it acts admirably, and the process may be repeated until there is no steel left to cut. T. T. PARKINSON.

P.S.—I have to thank those gentlemen who have kindly suggested improvements in the magnetic engine. I have finished mine, which works with two of Daniel's cells; the fly-wheel, 10in. diameter on a perpendicular shaft, working a pump if required, and giving a shock.

TELEGRAPHIC REFORM.

Sir,—Perusing your valuable issue of the 9th inst., I was much pleased to find that the hon. member for Edinburgh had presented a petition to the House on "Telegraphic Reform." It is a fact that much improvement could be made at a trifling expense, and the whole of Her Majesty's subjects would be greatly benefited had the Government taken steps in the matter. It is evident that thousands of our fellow creatures are excluded from the present system, and I cannot see why it should be so. Had our Government voted a small item of the cash (so readily disposed of) for the erection of telegraphic stations. I doubt not but they would prove more serviceable than an Iron-clad in case of an invasion. Let the wires be extended and offices established throughout the British dominions, and if they would not prove to be self-supporting—let our country policemen attend to the instrument at certain hours daily. J. MORGAN.

TEMPLATES.

Sir,—Allow me to correct some mistakes which are made in my solution to the problem given by Ceterates in your impression of March 9th.

The lines A D and B E should *not* be dotted ones, but black like the arches A C B and D J E.

Neither should the straight line G O be a black one, it should be a dotted one, so that the black lines may represent the outlines of the templates.

Again, your compositor makes it appear that I find

$$S = C\left\{\frac{h}{C-c} - \sqrt{\left(\frac{h^2}{(C-c)^2} - \frac{1}{4}\right)}\right\}$$ whereas it should be

$$S = C\left\{\frac{h}{C-c} - \sqrt{\left(\frac{h_2}{(C-c)^2} - \frac{1}{4}\right)}\right\}$$

Again he makes me say

$$K\,O = \sqrt{\left\{h^2\left(\frac{C}{C-c} - 1\right)^2 - \frac{C_2}{4}\right\}}$$

Now if your readers will write $\frac{c^2}{4}$ for $\frac{C_2}{4}$ all will be right.

Then will $s = h\left(\frac{C}{C-c} - 1\right) - \sqrt{\left\{h^2\left(\frac{C}{C-c} - 1\right)^2 - \frac{c^2}{4}\right\}}$

DAVID KNIGHT.

CUTTING CARBON, &c.

Sir,—Acting upon the suggestion of Mr. Tonkes which appeared in No. 46 of the ENGLISH MECHANIC, I procured some carbon at a neighbouring gas retort, but on attempting to cut it into shape, I found it impossible to do so with any saw which I possessed, indeed, so hard was it that on chipping it with a hard chisel it struck fire repeatedly. The composition of this carbon was extremely dense, unlike that commonly sold, which is very porous and easily worked. Now perhaps Mr. Tonkes will kindly inform me of some means by which I may cut this refractory carbon, for it is an excellent conductor of electricity, and I experimented with a small piece chipped from the large block with very satisfactory results.

I would now propose a simple query to Mr. Tonkes, not in the position of a critic but as one seeking for information. He states in No. 41 of the MECHANIC that "carbonic oxide is the deadly gas which kills people who descend into wells." Now as carbonic oxide is lighter than common air, how is it possible that it can, in direct opposition to the law of gravitation, remain at the bottom of a well?

GALVANI.

CONSTRUCTION OF SPECULA.

Sir,—As some of your correspondents appear to take an interest in anything relating to the construction of specula, I forward the results of some experiments I made in 1857 and 1858 with the view of seeing whether it was practicable to manufacture, at a cheap rate, specula and other articles having a highly-polished surface by electro deposition. The following particulars, extracted from a letter addressed to several firms and also to the Society of Arts in 1858, will give all the hints required by any amateur desirous of making use of this process:—

"It is to manufacture by electro deposition all kinds of reflectors, any number of each kind being produced from one single copy or from a mould taken from that copy. It is chiefly intended for the production of those reflectors which in the ordinary way require a great amount of time and labour to bring them to the requisite form and polish, such as specula for reflectors, microscopes, light-house reflectors, or reflectors of heat and light, as used in any kind of optical apparatus, or by scientific experimenters and others; or it may be advantageously employed in the production of reflectors for common use, having either plane or curved surfaces, and also in producing a better kind of daguerrotype plates having a more evenly-deposited surface than those made in the old way or those electro-silvered.

"Plane-surfaced reflectors may be made by depositing on a previously-prepared copy, and the better the first copy is prepared on its surface the finer will be the polish on the surface of the copies taken from it. Curved or any other kind of surface than plane requiring a mould to be taken from the prepared copy, and from this mould the number of copies required are to be taken, or as this process might often be too slow any number of moulds might be taken from the copy, and then the rapidity of production increased as required. It is evident that the same process might be pursued in the production of plane surfaces.

"Silver or platinum would probably be the best metal for the best reflectors, but as the prices of these metals are very great only the surface need be coated with them, the rest being of any common metals, as iron, copper, zinc, tin, &c. The copies may first be taken in any of these common metals or a mixture of them, and then a film or thin layer of the reflecting metal precipitated on the polished surface. In the case of silver being preferred it would be best to use the silvered solution containing 82 C (bisulphide of carbon) or other substance to form a bright deposit and save polishing; or a thin layer of the reflecting metal may be precipitated on the mould and then covered by a common metal, or two or three layers of common metals to the proper thickness. In order to save expense it might be advisable when a little thickness is obtained by precipitation to increase the thickness and strength by the addition at the back of any metal—alloy, amalgam, or other substance fusible at a low temperature, or at any temperature below the fusing point of any of the metals precipitated. If a high heat is required to melt the metal employed care must be taken by the usual precautions of slow cooling to prevent uneven contraction. Fusible metal will do, or lead, tin, bismuth, zinc, &c., used separate or mixed with each other, and with powdered mineral substances to give additional strength.

"There are other reflecting metals which might be employed advantageously, and which would be much cheaper than silver, as nickel, antimony, bismuth, tin, &c. The white metals would be best for reflecting light; for reflecting heat the surface would very likely be best of brass, and this could be done by precipitation, or perhaps it might be done by a loying the copper surface at a high temperature with zinc. Though this I have never tried, the copper surface may, however, be alloyed with tin, by rubbing melted tin on the heated surface, or by immersing the reflectors, having a brass surface, in a solution of cream of tartar and tin in the same manner as brass articles are tinned, the solution dissolving the zinc of the brass and precipitating the tin which forms an alloy with the copper, thus producing a surface of real speculum metal; this may be afterwards rubbed a little to increase the polish. Slightly oiling the surface of the mould is not necessary, but should this method be adopted for the greater ease of separation, the copies taken would have to be rubbed a little with protoxide of iron or other polishing material, though very little rubbing would be needed.

"Moulds may be made of fusible metals or an amalgam, though the copies taken from this require polishing afterwards. Non-metallic moulds may also be used, when covered with a conductor. It is needless to say that the copies taken in this way would take some trouble afterwards in polishing.

"Wax moulds, or a mixture of wax and other substances, gutta-percha moulds, or, in fact, nearly all kinds of moulds, may be made conductors by the usual way of rubbing them with blacklead, or silvering the surface by Parkes' process, but the following, which is somewhat similar, though cheaper answers sufficiently well. Dissolve phosphorus and wax in common naphtha, cover the surface of the mould with this solution, and when nearly dry dip it in the silver solution. Glass moulds may be done in the same way, though not by the blacklead process. Drayton's process of silvering glass seems also to act remarkably well in rendering glass and other substances good conductors; but this process has a special advantage—viz., that when the silvered surface is covered by precipitation of other metals, these metals and the silver may be taken off together, leaving the glass or other substance clear, thus giving a silvered speculum, with the surface as highly polished, or nearly so, as the glass surface itself.

"Should the above prove completely successful in the large way to your own satisfaction, there can be little doubt but that there will be a large demand, especially as they may be made comparatively cheap; they may even be made cheap enough to be within the reach of the working amateur who would prefer them instead of glasses to form his telescope; or they might equally be made to the same dimensions and perfection of parabolic curve and polish as the finest specula of Professor Lassell and Lord Rosse, if such could be obtained for the purpose."

I scarcely need mention that the silvering of the glass or other surface could now be much more easily accomplished by M. Petitjean's process, described some time ago in the ENGLISH MECHANIC. If any of your readers would take the trouble to construct a really good speculum, he might take any number of copies, and sell or exchange them for other articles amongst others of your readers. J. H. M.

WHEELS FOR SCREW CUTTING.

Sir,—In finding a set of wheels for screw-cutting the first thing to be considered is the proportion which the screw it is intended to cut bears to the leading screw of the lathe, for the number of teeth in the wheel on the mandril, and the wheel on the leading screw of the lathe, should be in the same proportion to each other as the screws. There are various methods of finding the wheels for cutting screws, several of which have been explained in the ENGLISH MECHANIC.

The plan I usually adopt is as follows:—I write down the number of threads in the screw I intend to cut, and also the number of threads in the leading screw, and I multiply both by any number I find most convenient for my wheels. Example: Suppose I wish to cut a screw with eight threads to the inch, and the leading screw has two threads to the inch; then $\frac{8}{2} \times 10 = \frac{80}{20}$ or $\frac{8}{2} \times 15 = \frac{120}{30}$ or $\frac{8}{2} \times 20 = \frac{160}{40}$, &c. If I have either couple of these wheels I can put one wheel on the leading screw and the other on the mandril, and I can fill up the space between them with any convenient wheels to act as dummies. I may state here that when a set of wheels work directly into each other (that is, all in the same plane, or, if you like it better, all of a row), the proportion is between the wheel on the mandril and the wheel on the leading screw *only*, and therefore it does not matter how many teeth there are in the dummy wheels, nor does it matter how many wheels there are, only that each wheel changes the direction of the motion. It should be remembered that if the screw it is intended to cut has more threads to the inch than the leading screw, the smallest of the two wheels is to be put on the mandril, and, if it has less, *vice versa*. Supposing the pitch of screw the same as above, the mandril should turn eight times while the leading screw turns twice, or, in other words, they are in the proportion of 4 to 1. If through breakage or some other cause I do not possess the proper wheels, then I have almost any amount of choice by proceeding as follows:—If I have the proper wheel for the mandril, and the wheel I wish to use for the leading screw has only half the proper amount of teeth, it is evident that the leading screw would revolve twice as fast as I require, for they are in the proportion of 2 to 1; or if I have the proper wheel for the leading screw, and the wheel I wish to use for the mandril has twice the proper number of teeth, it is evident that it amounts to the same thing. I can get over this little matter by using any two wheels, which are in the proportion of 2 to 1 (say 20 and 40, or 30 and 60, or 40 and 80, &c), and coupling the two firmly together, so that the largest wheel of the two works into the mandril wheel (or dummy working into the mandril

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wheel), and the smallest into the screw wheel or dummy. If the wheel I wish to use for the mandril is only half the proper size, or the wheel on the leading screw is double the proper diameter, then the smallest of the two wheels works into the mandril wheel. If the wheel I wish to use for the mandril has one-third more, or the wheel on the leading screw one-third less teeth than I require, I can proceed in the same way as before by using two wheels, one of which has one-third more teeth than the other, say 30 and 40, 45 and 60, or 60 and 80, &c. The wheel on the mandril being too large, or the wheel on the leading screw being too small, the leading screw would turn one-third faster than I require it to turn; therefore the largest wheel of the two works into the mandril wheel. Of course if the mandril wheel is too small, or the leading screw wheel is too large, the screw wheel would revolve one-third too slow, therefore the smallest of the two wheels would work into the mandril wheel. I may here state that when I find that the wheels I have to use for the mandril and leading screw would cause the leading screw to turn ¼, 1-5, ⅓, &c., too fast or too slow, I can use for the intermediate wheels any two wheels, one of which has ¼, 1-5, ⅓, &c., more teeth than the other, and it should be remembered that if the wheels would cause the leading screw to turn too fast, the largest of the two intermediate wheels should work into the mandril wheel; and if too slow, then the smallest of the two works into it. When a person is used to this plan of looking at the proportion of the wheels it will be found very handy. For instance, should the lathe be set for cutting four threads to the inch, and an odd job comes in with twelve threads to the inch, I can leave the mandril wheel and the screw wheel as they are, and use any two wheels which are in the proportion of 1 to 3, say 20 and 60, or 25 and 75, &c. I might proceed in the same way with 6, 8, or 10, &c., threads to the inch, but I think sufficient has been said to enable anyone to think the matter over for himself.

JAS. CONNOR.

ABERRATION.

Sir,—Allow me to express my thanks to your talented correspondent "F.R.A.S." for his elaborate description of aberration. Perhaps he will be good enough to explain how it is that aberration is not affected by natation. After a while I shall have pleasure in referring to his description of aberration. The price of Main's Rud. Ast., Weale's Series, is 2s. Thanks also for your information respecting "Gent. Magazine."

BICKERDIKE.

SCREW PROPELLER.

Sir,—Will you allow me to make a few remarks regarding Mr. Thompson's folding screw propeller?

So far as I am able to understand Mr. Thompson's drawing, I believe his sliding bush or boss passes over the main propeller shaft, from his straps right through the stuffing-box to his crabbs; if so, this sliding boss cannot be made to fit very accurately, or the effect of corrosion would prevent its sliding action; and to allow a sufficiency of space to stop the effect of corrosive interference would be to take from the propeller shaft its most important permanent supports or bearings, and make it liable to produce a tremendous chattering in the slide boss.

Mr. Stewart, in one of your early numbers, particularly cautioned intending inventors against one point, which I think Mr. Thompson has entirely lost sight of—viz., that any apparatus for accomplishing the object of feathering the screw should not be liable to have its action impeded or destroyed by the entwining of weeds, ropes, or other sea refuse, around the screw shaft. I think it will be seen by reference to Mr. Thompson's drawing that he has entirely neglected to make any provision against this evident ordinary casualty, for on looking at the tracing it becomes evident that anything entwining itself between the slide boss and cylinder marked C, would entirely prevent the action of his apparatus. I do not myself like the action of these straps or bars in the water, as their rotation is against the power of the engine, with no advantage to the progress of the vessel.

A. SAXON.

AMATEUR LENS GRINDING.

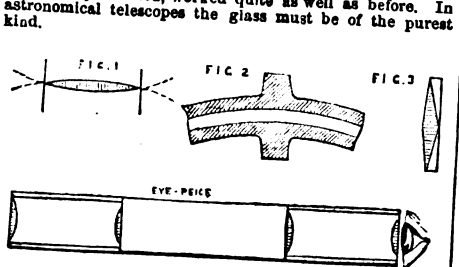
Sir,—If working men in general knew how simple is the process of grinding and polishing lenses for telescopes, cameras, &c., &c, I am certain that more would amuse themselves in that interesting science; it would also be the means of opening the doors to many other branches of science. In my youth I was much surprised to see a shoemaker in Edinburgh grinding and polishing lenses for telescopes of 3, 4, and 5 inches diameter, sitting on his "cobbler's stool," and I have had the pleasure of looking through them at a test object, and was so interested that I soon commenced and succeeded in making various optical instruments; and in answer to "A Tinplate Worker," "A. M.," "Cygnus," and others, I must state that a knowledge of conic sections, specific gravities, refraction and dispersion of light through prismatic bodies, although quite necessary to succeed as an optician, need not frighten them, because as long as the pages of the ENGLISH MECHANIC are open we can explain the modes in subsequent papers. Once but grind a glass and it is the same for all.

Suppose "A. M." wished to grind a lens for a telescope, he must first determine the length of focus and diameter of lens for the object glass, and make a drawing on paper, he will then find by the drawing the thickness of glass required. We will suppose he commences on a small lens of 1½ inch diameter and of 15 or 18 inches focus. He must draw two short lines parellel to each other 1½ inches apart, next open a pair of compasses to 5 inches and draw a portion of that curve betwen the lines as in Fig. 1. Next procure a piece of plate glass of the thickness shown by the drawing, and nibble it round with a pair of pliers, using a circular piece of paper as a guide. Smear one side of the glass with pitch and stick it on a cylinder of wood of the same diameter and 3 inches high; the crown lens will then be ready for grinding.

The tools for grinding are either of iron or brass; brass will be best for the amateur. Take a piece of thin zinc twice the width of the lens and with the compasses at 5 inches, describe a portion of that curve across the zinc, and separate the zinc at the curve; he will then have a couple of patterns to get the brass tools made by. If "A. M." has not got a turning lathe, he must go to a wood turner's and get two patterns made to fit the zinc gauges; the patterns must have a stud on each as in Fig. 2 whereby to fasten a bit of wood with pitch, to act as a handle. After the patterns are cast in brass they ought to be again turned to fit the gauges, and finally rubbed together with emery until they fit each other. A tool the width of the pages of this journal, at 5 inches curve, would grind nearly a dozen lenses at one time—but, of course, an amateur need not have them but a little larger than the lens.

Next procure from Messrs. Acton's, emery grinders, in Farringdon-street, three kinds of emery, ½lb of the finest washed emery, 1lb. fine grained emery (a little coarser than flour of emery), and 1lb. coarser still. Begin and rub the glass with the coarse emery with water, using the hollow brass tool until the glass is ground of the same curve as the tool. At this stage "A M." would not be able to see through it, because of the great hollows dug into it by the particles of the coarse emery. Therefore, wash away all coarse particles and rub again with the next degree of emery which will put a finer surface upon it. Wash all this off the glass again, and with the finest emery put the last grain on the glass previous to polishing, using a strong magnifier to look for scratches; being satisfied the lens has a fine equal grain all over and free from scratches, wash all clean and prepare the polisher. Procure at Acton's ½lb. of the finest putty powder, warm the brass tool and smear the inside of it with pitch; lay a piece of fine cloth over the lens and turn up the tool with the pitch upon it; the cloth will stick to it and when cold smear the cloth with the putty powder and water, rubbing the lens until on looking with the eye glass no trace of the effects of the fine emery is seen. Warm the lens before a fire, slide it off the wooden holder, wash the pitch from the lens with turpentine, spirits of wine, or other solvent, and he will be delighted to find that he has ground and polished a plane convex lens of 10 inches focus, it being a rule in optics that a lens ground on one side only will have its focus at twice the radius; but ground on both sides, will have its focus at the radial point. "A. M." must now turn the other side, taking care of the feather edge as he approaches it, by not going so far with the coarse emery or he will break the feather edge. When the second side is finished, he will have a crown lens of 5 inches focus, and as "A. M." having succeeded in polishing glass, no doubt he would like to make his terrestrial telescope an achromatic one by adding a concave lens of flint glass to it.

We will now suppose the crown lens is finished; but as its form is thick in the centre and thin at the edge, it will be similar to a circular prism, and would show all objects with the chromatic colours, another lens must be ground that is thick at the edge and thin in the centre, to counteract the dispersive power of the convex lens, and as flint glass has in general twice the specific gravity of crown, and consequently has twice the dispersive power, it will, of course, do the same amount of work with one half the angle of the crown lens as in Fig. 3, and so reunite the coloured rays and form again white light. We will also suppose that "A. M." does not wish to trouble Messrs. Houghton's glass warehouse, High Holborn, for any of Messrs. Chance's discs of flint glass, but that, as an experiment, he will grind one from the bottom of a flint glass tumbler. He must grind it on a flat stone to the proper thickness, and also get it to the diameter by taking a strip of sheet iron an inch wide and bend it so as to form a collar, and by putting emery and water betwixt the collar and the glass, by pinching the collar with the fingers while the glass revolves on the nose of a wooden chuck, will reduce it in a few minutes. After it is the proper diameter and thickness, commence rubbing it on the convex tool and finish it in the same manner as before; he will now have a concave side finished which will fit the convex lens; take it off the holder and turn the last side up, and now learn that it is a very difficult thing to grind and polish a surface truly flat, so that "A. M." had better grind the last side concave upon a tool of a large radius, say 30 inches. The two glasses must then be cleaned and made warm gradually before a fire; a drop or two of Canada balsam being let fall into the concave lens, drop the convex one on it, press the air bubbles out and when the balsam sets he will have a small achromatic lens. The streaks or striae in the bottoms of tumblers are not of so much importance in a terrestrial telescope. I have had some of Voigtlander's best photographic lenses full of air bubbles, and some when accidentally cracked, worked quite as well as before. In astronomical telescopes the glass must be of the purest kind.



"A. M." will now take his compound lens and try its focus by the sun, and make the tube 3 or 4 inches longer so as to support the magnifying tube called the eye-piece. The object lens will form an image of any thing within the tube, say the clock dial of a distant church—the tube called the eye-piece merely magnifies this image, and a variety of eye-pieces may be used for the same object glass, according as a high or a low power is required—in short, a telescope may be compared to a camera obscura with a microscope attached, to enlarge the image formed by the object glass.

Now then about the eye-piece. The subjoined formula may be taken, because the lenses for it are all planos, so that he will only have to grind one side of them, if a piece of plate glass be used. Focus of front lens 1⅜ths, ditto of second lens 1⅜ths, ditto of third lens 1⅜ths, ditto of lens next the eye 1¼th. The first and second lenses may be a little under ½ inch diameter; the third or field lens may be a little more than ½ inch diameter; and the lens next the eye may be about ⅜ths diameter.

Let "A. M." make two short tubes 1½ inches long (they are called cells), and fix his lenses to each end of the two tubes or cells, then take a tube called the eye-piece 6½ inches long, and slide the two cells into each end of this tube, he will then have an eye piece which must slide into the larger tube to focus on the image formed by the object glass.

PARACELSUS.

OUR SUBSCRIBERS' NOTES AND QUERIES.

HEAT WANTED.—I have a galvanised iron box 15 in. long, 12 in. broad, and 4 in. deep, with tight cover, which I want to fill with water and keep it at a temperature of 105 degrees night and day by means of gas. Wou'd any reader oblige me by telling me the best and cheapest mode of obtaining the required heat and the probable quantity of gas required per hour?—MILLWRIGHT.

POWER OF WATER WHEEL.—Can any mechanical reader give the correct method of obtaining the power of the following water wheel, and oblige? 16 ft. dia. × 16 ft. wide, running 223 ft. per min.; water-course (less wood guides) 29 ft. 4 in. or 29½ square feet, 8 ft. fall. Centre of water-course falls into the buckets at angle of 158 from centre of wheel. I call this a breast wheel, with open buckets.—J. B.

BRITANNIA METAL.—Can any reader inform me how to make white metal cheaply? I want to cast small images and such like articles.—H. F. L.

GRINDING AND POLISHING.—If Mr. Edward Pickles possesses any better knowledge of grinding and polishing lenses than what has been given in the ENGLISH MECHANIC, why does he not give it to the world for the benefit of the readers? Are we not adding our mite every week for his benefit?—DAVID KNIGHT.

TUBING FOR TELESCOPES.—Will any reader tell me where I can get brass tubing suitable for telescopes and microscopes?—DAVID KNIGHT.

SPECULUM.—Will "An Amateur Turner," page 338, kindly furnish me with information regarding the construction of the glass speculum he advises "Astro" to make, as I wish to make one?—X + Y.

DIAMETER AND THREAD OF SCREW.—Will some reader inform me what would be the proper diameter and number of threads to the inch (Whitworth's standard) for a screw to carry a slide rest for a 5-inch and for a 6-inch centre foot lathe? I should also be obliged for some information as to the proportions requisite in the wheels and pinions of simple back-gear.—DAVID COPPERFIELD.

POWER OF STEAM ENGINE.—Can any correspondent tell me why 33,000 lbs. is taken as the standard for calculating the power of a steam engine as 2,240 lbs. are equal to one ton?—A. F.

CHARCOAL.—Will J. K. K, who publishes the receipt for polishing brass work, give the address of any party in town or country who will supply me with a small quantity of genuine charcoal?—ANY HAND, FIRST.

TURNING.—Will any reader explain the method of turning in wood a twist same as a corkscrew, about seven twists in ten inches, more or less?—TWISTS.

TURNING.—Will some correspondent inform me how to make small screw pins about 3-32 diameter and ¼-inch long; also what kind of steady is best for turning light shafting, about 1½ diameter and 6 feet long?—MONITOR.

TURNING.—Will any correspondent inform me of a handy way to turn bowling-green balls? The way that I have adopted has been this: I have turned them in a foot lathe by hand, and have got them to the right gauge or shape by trying on a piece of sheet iron cut out to half a circle —T. W. S.

FEATHERING PROPELLER.—Will H. H. favour me with a rough sketch of the Prince Alfred feathering propeller, or an explanation of the same, as I am familiar with Mr. Woodcroft's already?—J. A. NEWLAND, Cathcart, N.B.

SCREW PROPELLER.—I shall feel greatly obliged if some correspondent will tell me how to "set off" the varying pitches of the screw propeller—I want to know how to draw the screw propeller—the pitch and diameter being given.—ASMODEUS.

EXTRACTING LEAD.—Will any reader inform me how to extract the lead from lead skimmings and dross mingled with sand and chloride of zinc, and oblige, X, L.?

SOLDERING JEWELLERY.—Can any correspondent tell me how the silver solder used by jewellers is made—how many parts of different metals, and how melted?—SOLDER FIX.

WORSTED SPINNING.—Will any subscriber inform me how to draw a heart wheel pattern to fill a straight or barrel-shaped bobbin, such as are used in worsted spinning machinery?—A POOR WORKMAN.

VARNISH.—I want information as to a good varnish for water-colour drawings; also the best way of testing a good oil-stone.—FLINT.

COLOURING JEWELLERY.—Will "Horologer" tell me what acid is used for colouring 15 and 18 carat jewellery?—ONE IN A FIX.

VELOCIPEDE.—R. J. P. tells us he has a velocipede in course of construction with great improvements in the treadle. I should much like to see a description of it in the ENGLISH MECHANIC.—S. H. C.

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FLUX FOR BRASS MELTING.—Will any one say the best flux for brass melting; or better, will any one give a description of best way to run small quantities of brass in an amateur's portable forge?—H. N.

STOPPING TEETH.—I am in the habit of using oxide of zinc mixed with chloride of zinc, which forms a hard filling for decayed teeth. I should be obliged if any reader can tell me how to make the chloride clear and free from white deposit, without the addition of water, and how to prevent the strong acid taste from the chloride; if it is possible to add soluble glass with the chloride in solution.—MOLAR.

POROUS CELLS.—I beg to thank "Anion" for the description he has given in No. 49 of the coil for charging a secondary battery. Can any reader inform me whether red ware (the material that flower-pots are made of) will answer the purpose for porous cells for a Daniel's or Bunsen's battery equally as well as porcelain ware?—D. BATHAM.

WELDING STEEL.—Can you or any correspondent oblige me with a cheap and simple recipe for welding cast steel?—VULCAN No. 1.

WATCH FACES.—Can any reader inform me how to mix the composition used to enamel watch faces?—NOVICE.

BLUE POWDERS.—Can any reader inform me what kind of blue is used for blueing blue powders?—H. BROWN DALTON.

ELECTRIC SHOCK.—I want to know how to make a shock felt at any distance, for the purpose of discharging powder to decompose water from a cylinder machine and Leyden jar; also how to make the varnish to cover the tinfoil of a conductor.—BUCK.

FORGING.—Will some kind reader oblige me with instructions for making an oliver for forging screw-pins and rivets, and the best way of driving the same by steam?—S. B. C

CUSHIONS OF ELECTRICAL MACHINE.—Will Mr. Tonkes kindly inform me which are the best materials to use to cover and stuff the cushions of an electrical machine? I have taken great pains to construct one with an 18-inch plate; I covered my cushions with thin basil leather, and stuffed with horsehair, but they do not act well; of course I use amalgam and connect the cushions with the earth. I have been advised to stuff them with iron filings, but I shall have confidence in Mr. Tonkes' directions if he will kindly advise me, as I have so often profited by his instructions to other correspondents.—E. H.

OUR SUBSCRIBERS' EXCHANGE.

I have a turning lathe, metal bed, V top, which I made some time since, and am willing to exchange for some other article.—Address W. D. NOAD, gunsmith, Norton, Durham.

I have a photographic apparatus complete, camera and stand, and plate holders, with chemicals and books complete, which I should like to exchange for a useful lathe and tools.—Address JOHN ROBERT EVANS, Palmerston-terrace, Church-lane, Wolverhampton.

DRAWINGS FOR ENGINE.—I have commenced to make a small beam steam engine, 2½ cylinder, 5in. stroke, and should like to get hold of some little cheap work giving proper proportions, details, &c.; or I am willing to pay for a set of working drawings. Can my fellow subscribers assist me? Address H. N., care of Editor of ENGLISH MECHANIC.

VELOCIPEDE.—W. H. Potter of 36, Queen's road, Bayswater, wishes Mr. Forbes to inform him, per post, where one of Mr. Forbes's velocipedes can be seen, also the cost of them.

IF Philip Carl will send his address to L. Todd, 7, Madeira-street, Leith, I shall be happy to treat with him as regards a drawing of furnace for welding tubes.—A. H. L.

The following books (in one lot) for some useful article, apply, by letter only, "W. E.," 10, St. David's-street, Brunswick-street, Dover-road, S.E. Bourn's Catechism of Steam Engine; Campin's Practice of Hand Turning; Bourn's Mechanics and Mechanism; Grier's Mechanic's Dictionary; Grier's Mechanic's Calculator; The Elements of Mechanism; The Practical Mechanic's Journal, vols. 5 and 6; The Artizan, vol. for 1850, and about 17 monthly parts Mechanic's Magazine for 1860 and 1862. All in good condition.

The Editor of the ENGLISH MECHANIC requests "Carbon" to forward his address, as a letter is waiting for him at the office.

REPLIES TO QUERIES.

HOROLOGICAL.—If H. Norton will state what kind of timepiece he is desirous of making, whether weight or spring, I will endeavour to supply him with the information required.—ONE IN THE TRADE.

CEMENT FOR CAST-IRON PIPES.—In reply to Mr. Young's enquiry, I beg to inform him that Portland or Roman cement makes an extremely strong cement for cast-iron hot-water pipes—so strong, indeed, that when once set firmly, the only way of disconnecting the pipes is by cutting them with a sledge and chisel, the joint itself being practically impregnable. This extreme tenacity is no doubt owing to some chemical action of the cement upon the iron, but of what nature I am ignorant.—C. A. F.

CEMENT FOR CAST IRON PIPES.—If socket pipes are meant—may also be used round an iron ring for flange pipes, two ounces of sal ammoniac, one ounce of sulphur, sixteen ounces of iron borings For use, one part of this mixture to twenty of clean iron borings. For joints of hot water (or steam) pipes nothing is better than a vulcanised india rubber washer. It crumbles and indurates but never melts. This cement must be moistened with water, and well rammed in. It will dry as hard as iron itself.—J. R. H.

MARINE GLUE may be poured upon a slab and cut in squares. When used, must be melted, if the thing to be attached can be warmed. "Inkpot" will find the adhesion more complete.—J. R. H.

LUTE FOR CRUCIBLES.—J. H. M. will find that the best lute for crucibles is a dough made with a mixture of fresh fire clay and ground fire bricks, worked with water. That cement, if made with solution of borax, answers still better upon some occasions, as it becomes a compact vitreous mass in the fire.—J. R. H.

LUTE.—Indiarubber when melted in a spoon will bear heat at which sulphuric acid boils. Glue, slaked lime, and white of egg is a good lute.—J. R. H.

MARINE GLUE.—Melt the glue in an ordinary glue pot, then heat the article to be fixed. Apply a thin coat of glue, and then bring the pieces together under pressure, and allow to cool. If properly done, the material will start before the joint gives way.—J. D.

BRONZING.—As I am not in the gas fitting trade, I can not inform H. A. Yeldar how gas fittings are bronzed of a copper or olive tint, but I will give him the method I have pursued myself with very good results. Make a pickle of nitric acid and water; immerse the article to be bronzed, and add some cuttings of white iron. This will give the brass a red tint; wash in water and dry, then paint with a paste made up of sour beer and the red oxide of iron ground fine and free from grit, allow to dry, and then polish with a dry brush, and dust off the red oxide of iron: heat and then lacquer with red lacquer; if the colour is not deep enough, polish again when cold, and lacquer as before. This gives a very beautiful dark copper tint. To relieve bronzed work, leave the places you intend to have bright unlacquered, then scrape with a hook scraper, and burnish with a steel or agate burnisher, and sour beer or argoll water; dry with tissue paper, and lacquer with yellow or red lacquer according to taste. Perhaps some reader in the gas fitting trade will oblige with the method pursued by them for bronzing brass of a copper colour.—J. D.

BELLHANGER'S BRACE.—In No. 49, T. W. suggests that my bellhanger's brace is not very practicable, and thinks it liable to break the bit. I still, however, think it far preferable to the one he illustrates as an improvement, and less trouble to use, besides being much cheaper to make. The socket A in mine revolves with the brace when not held firmly in the hand, thus taking the pressure off the bit when necessary. It has been in use now for months, and has been through some rough work, and I am better with it every time I use it.—E. H.

METALLIC TELLURIUM.—R. Ross will find it difficult to obtain metallic tellurium; he can get tellurium ore of Jackson and Townson, Bishopsgate-street, at about 2s. 6d. per dram.—E. H.

LIQUID COLOURS.—H. P. can get liquid colours prepared expressly for photographs of Mr. Cox, Skinner-street, Snow-hill. The photographs require no sizing.—E. H.

SPLITTING FRUIT STONES.—If D. S. S. has access to a bean splitting mill, his cherry stones may be cracked "en masse."—J. R. H.

NAPHTHA.—W. Pickard says naphtha is worth 1s. 4d. a quart to dissolve shellac, which he quotes at 1s. 8d. to 2s. per pound. I get naphtha (coal naphtha) at 2s. the gallon, or 6d. the quart, and shellac at 1s. 1d. or 1s. 2d. for my amateur experiments. No better need be used.—J. R. H.

FLUTING TAPS.—In answer to C. W., in No. 49, concerning fluting taps in a screw cutting lathe, if the information of one who has fluted scores will be of any avail to him, I give it freely. He must prepare a tool of the form usually called a knife or side tool, left hand, or such as is used for turning the sides next the mandril. The taps must be held tight between the centres without carrier; the face plate being off, the tool is fixed in the tool box with the point towards the fast headstock. The slide rest is then used as a planing machine, being worked backward and forward by the lever handle, and the tool gradually set into the work by the cross slide.—ANY HAND FIRST.

BEVEL WHEELS.—Let the thickness of the wood cog be to the iron tooth in the ratio of 38 to 25; this will make them nearly equal in strength.

To find the least thickness of iron tooth which should be used to transmit a known power, apply the following rule:

Let T = least thickness of tooth
" H = horse power of the first mover
" V = velocity in feet per second of the pitch circle of the wheel,

Then $T = \frac{3}{4}\sqrt{\frac{H}{V}}$

Suppose now that we wanted the thickness of a tooth that would transmit 30 horse-power with a velocity of 12 feet per second at the pitch circle, then

$$T = \frac{3}{4}\sqrt{\frac{30}{12}} =$$

$$T = \sqrt{75} \times 1{\cdot}58$$

$$\therefore T = 1{\cdot}185$$

For the least thickness of tooth, and allowing 1-10th for clearance, and then multiplying 1·185 by 2·1 gives the pitch as equal to 2·4885 or 2½ in. nearly. The wheel is generally cogged, and the pinion iron, unless there are particular conditions which prevent this being done, as in the case of a steam engine fly-wheel, which drives the first motion where the wheel is usually iron, and the pinion cogged.—J. D.

F. W. WALE will find that the idea of working long submarine lines by batteries at both ends at the same time is in use, and is mentioned and even illustrated in Van Choate's specification. J. H. M.

HAROD wants a receipt for making an amalgam of copper with aluminium. I suppose he means an alloy, for the term amalgam is only applied to alloys containing mercury. He will find in No. 29, page 28, how it is made in the large way. In the small way he will probably succeed by heating to the melting point of copper, or a little higher, in a blacklead crucible, or a clay crucible lined with charcoal and well covered, an intimate mixture of finely-divided copper, alumina, and charcoal powder. He may procure the copper by putting in a solution of sulphate of copper a piece of iron; the copper will be precipitated in powder, or the oxide of copper may be precipitated by adding to a similar solution an alkali not in excess. Alumina in like manner may be precipitated from a strong solution of alum, by adding an alkali or a carbonated alkali. J. H. M.

If J. H. M. (2) wants to join two crucibles very firmly together, he will find it is not very easily done. Stourbridge clay and a little sand mixed together with water, as recommended by Geo. Hardey, contract when allowed to dry, leaving cracks. These should be filled up by a somewhat thinner mixture and allowed to dry again, and the operation repeated if cracks still appear. Stourbridge clay alone used in this manner would make a stronger joint. If strength is the object let the top crucible be considerably smaller than the bottom one, so as to increase the depth of the groove between them; but if strength is not required, increase the proportion of sand as much as possible, but not to the extent of making it friable, and then the contraction will be little or none. J. H. M.

ANSWERS AND NOTICES TO CORRESPONDENTS AND READERS.

ALL letters intended for the Editor should be addressed to 75, Fleet-street.

LETTERS applying for information to be furnished by post cannot be attended to.

Correspondents are requested to keep copies of their drawings and manuscripts, as the EDITOR cannot undertake to return such as may be rejected.

H. H. K.—Apply to a respectable patent agent. If all you state is correct the invention is valuable.

A. FAWCETT.—Your builder has charged you only the usual price. On referring to Burnell's Price Book (Lockwood and Co.) we find that, "In measuring carpenter and joiner's work, girders and binders of bridged and ceiling floors are to be measured, and allowed as framed; *also* gutter plates," &c. Referring to the scale the prices are perfectly correct. Get the book and see for yourself.

A. Z. (Kensington).—We should not advise you to seek for a patent. You had much better sell your invention to one of the large manufacturers.

IGNORAMUS.—Such directions would be useless unless accompanied by numerous diagrams. You had much better advertise for a cheap second-hand engine.

IRON.—Exceedingly well written. We much regret that we cannot spare space for insertion.

STUART FERGUSON.—The diamond is nothing but pure charcoal. The thing may be cheaply proven. Thus: Buy a waste diamond at a lapidary's (3s. or 4s.), and, fixing it to a piece of platina or iron wire, hold it till red hot in the flame of a spirit lamp urged by a blow-pipe; then plunge it in a jar of oxygen gas, and you will see it burn rapidly and give out a brilliant white light. Then, removing the holder from the jar, pour in a little lime water; chalk will be formed, carbonic acid having been given off during combustion.

AVELING AND PORTER.—Too late for this week; will be noticed in next issue.

LAMBETH.—We regret that we are unable to comply with your request.

A CHEMIST.—Ground flint can be bought of Mr. Jones, chemist, High-street, Stoke-upon-Trent.

ROBERT SLOANE (Glasgow).—We thank you for your suggestions, but it is not in our power to carry them all out. Diagram and communication next week.

MARK HENLEY.—Copy returned per post. At some future time you may succeed in producing an article more up to the mark.

H. W.—Vol. I. will shortly be reprinted.

CARBO.—The cells in the bread are the effect of carbonic acid gas, produced in fermenting dough. The yeast added to the dough produces the gas, which is driven off by the heat.

J. W. Y.—To make sulpho-cyanic acid for your uses, put into a test tube about equal quantities of prussiate of potass, carbonate of potass, and sulphur, all in fine powder. By the spirit lamp raise them to a red heat; keep the mixture thus for some time, dissolve out by water, filter the solution, and put it away well corked.

WOLVERHAMPTON.—So much depends upon the plan of the building to be heated, that it is impossible to comply with your request without a more clear explanation.

FLINT.—At some future date.

J. H.—Edgley, 43, Lamb's Conduit-street.

ENQUIRO (Bolton).—If you require an answer for the purpose of settling an argument you must put the question more clearly.

STANNARD'S WATER MOTOR.—This improved water motor was illustrated and described in No. 7, Vol. I., of the ENGLISH MECHANIC, and we have had numerous enquiries respecting it. In answer to E. A. P. and the questions of other correspondents received during the week, we repeat that the Stannard Water Motor is an American patent, and that information relating to it can be obtained from Munn and Co., 37, Park-row, New York, U.S.

PETER D.—No trouble whatever. We would have thought a decent schoolbook contained the information. Lead is obtained from galena; the ore is roasted with coal, then smelted, and run off into bars. The ore of zinc is calamine, and when melted into cakes it is called spelter.

JOHN MELLOR must state the oil used, and the particular purpose of the engine.

LOYALIST.—We advise you to make a few experiments before taking steps for a patent.

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W. G. Martin.—1. The article will be continued shortly. 2. Much depends upon the depth of the well and the soil.

An Enquiring Reader.—We are aware that the boilers of the old and unimproved engines have exploded more than once. The firm you name have other engines in hand, in which the faults pointed out by you will be cleared away. We have never applied to them for any information.

H. F.—An article will shortly appear.

Charles Hunter.—You can keep your chemicals dry in bottles. Your lens will have to be ground and polished.

A Cottingham Subscriber.—We should advise you to purchase one; you can do so at a cheaper rate than you can buy the chemicals, to say nothing of the bother and chance of ultimate failure.

A. G. G. Enquirer.—Too lengthy for present number; perhaps in the next.

Tyro.—Simply because the steam is used on both sides of the piston, and the used steam is condensed in a separate vessel.

B. A——r.—The one radiates heat more quickly than the other. Fill a polished and a blacked can with hot water; note the temperature in half an hour. The water in the bright can will be much hotter than that in the other. The passage of sound is more rapid through solids than through air. Try.

George Barrett, Povas, Blackburn.—The numbers you name will shortly be reprinted, when your local newsvendor will be able to obtain them through his London agent.

J. Martin.—We have inquired, but have been unable to obtain the information. The business appears to have been transacted through an agent.

G. W. Fowles.—It is a peculiar process of tanning.

W. D. Noad.—We shall be glad to receive the description of your figure lathe.

Strabo (Nieukoping).—Thanks for your wishes. Mr. Müller will provide you with your numbers regularly. Respecting your queries, iridium and osmium are of somewhat similar character to platina; in fact they are generally found with it in nature. 2. Manganese is chiefly employed in the manufacture of bleaching powder to produce chlorine, and to give a colour employed in calico printing.

B. Griffiths (Bilston).—Apply to the proprietor, 40, Cranbourne-street, Haymarket, and you will obtain full particulars.

J. P. (Hackney).—We feel grateful for the praise you award us, and though we must admit that we have received many similar suggestions since the English Mechanic was started we see much to prevent us from making the change. The newsvendors and publishers assure us that it would greatly injure our sale, and we are certain that thousands of our readers would object to any change at all.

Z. O.—You had much better advertise your invention or seek the assistance of a partner to carry it on.

An Apprentice Fitter.—Of Spon, the publisher, Bucklersbury, or of Messrs. Longmans and Co., publishers, Paternoster-row.

Bickerdike.—Next week; no time to engrave diagrams for present number.

R. H. Smethurst.—Explain more fully how the wheel is at present fixed and what driving.

Horologer.—In our next.

T. King.—If you search through the back numbers you will find plenty of information.

A. Cranston.—Received.

Andrew Paterson.—Under the circumstances we should consider the friction rollers as perfectly useless.

J. H. M.—We consider it a very useful book, but it perhaps contains more theory than practice.

G. T. B.—Enquiries are being made.

Wm D.—We cannot assist you as we are not aware of the correct address. Why not make enquiries in the trade?

Portsea.—If your enquiry be worded to your meaning, then, unless under peculiar circumstances, obtaining a situation on the Board of Trade staff requires some *interest*. Your certificate would be your *basis*. Send an application to the Secretary of the Board, Whitehall, and he, or the proper official, as in the course of his duties, will send you the information. Should you require a situation on board one of H.M.'s ships, then you should apply to the Admiralty; and if you have any "influence" you could bring to bear, the better will be your ship.

S. P. Q.—There is no *book* on aniline dyes. The best account of them is in Dr. Hofmann's Exhibition Report.

T. Davis.—Consult Lardner's "Museum of Science and Art."

Errata.—Allow me to correct a few printer's errors in the communications you did me the honour to insert in No. 48 of the English Mechanic. Page 318, Ventilation, line 13, for "deterring" read "determining." Notes and Queries, for "accoustics" read "acoustics." Page 319, Horse Power, line 3, for "this by" read "this multiplied by." Cylinder, line 1, for "Greer" read "Grier;" line 3, for "inch by radius of cylinder, cohesion," read "inch × radius of cylinder ÷ cohesion."—J. H., Amateur.

*** We have to ask our correspondents to sign their communications that they may be able to recognise the answer. "A Subscriber" is no signature—we have them by the thousand; the same with "Well Wisher," &c.

PATENT RECORD.

Selected from the Commissioners of Patents' Journal.

APPLICATIONS FOR LETTERS PATENT.

678. Eugene Rimmel, Strand, Westminster, an improvement in portable fountains.
680. William Robert Lake, 8, Southampton-buildings, Chancery lane, improvements in machinery for making bolts, rivets, spikes, and other similar articles.
684. Alfred Vincent Newton, 66, Chancery-lane, an improved mode of and apparatus for working air engines.
689. Alfred Stoddart, Brook street, Kennington-road, improvements in apparatus to be employed in illusory exhibitions.
690. Henry Francis Davis, 54, Bayham street, Camden-town, manufacturing artificial tea from pure bichromate of ammonia, for a drawing room entertainment entitled the tartarean volcano.
693. George Randle, 125, Vauxhall-walk, Lambeth, improvements in apparatus for conveying tidings of the loss or distress of vessels at sea, also applicable for conveying lines on shore from stranded vessels.
701. William Atkinson, Eagle Foundry, Northampton, improvements in apparatus employed in casting metals and other materials, and in the means employed for forming such apparatus.
705. James Tomlinson, Liverpool, improved means for indicating the quantities of liquids contained in casks and other vessels.
715. Victor Duterne, 111, Boulevart de Vantgirard, Paris, an improved metallic stuffing box called autoclave
716. Thomas Pattison, and John Booth Reddish, Lancaster, certain improvements in metallic pistons.
723. Henry Temple Humphreys, 28, Westbourne park-road, improvements in reflecting optical instruments.
726. Lieut. Col. James Baker, Army and Navy Club, Pall mall, improvements in magnetic engines.
729. Richard Larkin, Elm Cottage, Old Brompton road, improvements in means or apparatus for obtaining light by the combustion of magnesium.

LIST OF SPECIFICATIONS, &c.

Published during the week ending March 10, 1866.

842. Treating rice, J. H. Johnson—4d
843. Ornamental metallic chains, E. Wolverson—8d.
844. Railway points and switches, H. C. Hurry—10d.
845. Looms, J. Milton—4d.
846. Presses, W. Miller—4d.
847. Signalling in railway trains and preventing burglary, A. I. L. Gordon—4d.
848. Sewing machines, E. H Smith—8d.
849. Apparatus for examining sewers and tunnels, R. W. Barnes—4d.
850. Mules for spinning and doubling, J. Dodd—10d.
851. Cotton gins, W. Richardson—10d.
852. Spittoons, J. H. Johnson—4d.
853. Labels, W. Betts—4d.
854. Utilizing the heat of steam, D. E. Blacke—4d.
855. Manufacture of combustible gas, W. Clark—6d.
856. Planing and shaping metal, J. Todd—2s. 8d.
857. Paring potatoes, &c., C. Burfitt—4d.
858. Signalling on railway trains, H. J. Walduck—4d.
859. Oil feeders or cans, J. Buckingham—8d.
860. Steam engines, J. Rooke—1s. 4d.
861. Casting ingots, C. J. L. Leffler—10d.
862. Furnaces, C. Matthews and J. Fereday—4d.
863. Traction engines, J. Bruckshaw & W. Underhill—10d.
864. Non-conducting composition, F. Le Roy—4d.
865. Apparatus for stamping and marking, G. Bishop—4d.
866. Railway carriages, J. C. Thompson and J. Green—6d.
867. Lubricating compounds, W. West—4d.
868. Ornamenting articles of glass, J. Williams—1s.
869. Grooming horses, J. Norris, jun—8d.
870. Printing ornamental fabrics, J. Millar & J. Laing—8d.
871. Compositions for coating vessels, J. C. Halkett—4d.
872. Concentrating or evaporating solutions, W. Walsh—4d.
873. Ships' yards and spars, T. Glover, jun.—4d.
874. Febrifuge, A. D. Gascon—4d.
875. Kitchen ranges, F. Thomas—8d.
876. Gas burners, F. A. Mocquard—8d.
877. Treating sea weed, R. Young and C. F. Glassford—4d.
878. Steel tiers, F. W. Webb—10d.
879. Ventilating blinds, H. W. King—4d.
880. Hardening and tempering steel, E. Savage—4d.
881. Fastenings for pins, buttons, &c., Pulvermacher—8d.
882. Forging machines, J. Wright—10d.
883. Sewing machines, W. N. Wilson—10d.
884. Cranes, W. Irlam—10d.
885. File-cutting machinery, W. Brookes—2s.
886. Cutting nails, &c., R. C. Robinson—1s. 6d.
887. Carding cotton, &c., E. Leigh and F. A. Leigh—10d.
888. Bridges and arches, F. A. Leigh—1s. 4d.
889. Drying warps, R. Holroyd and J. H. Bolton—10d.
890. Lowering ships' boats, A. Chaplin—8d.
891. Heating the blast for furnaces, J. Player—10d.
892. Treating fatty matters, S. Childs, jun.—4d.
893. Reducing waste for manure, W. M. Fuller—4d.
894. Hammock, T. W. Nordenfelt—8d.
895. Transferring railway waggons, G. Greenish—4d.
896. Shaping machines, W. M. Neilson—4d.
897. Reflectors, B. Baugh—4d.
898. Dressing flour, W. Savory—1s. 6d.
899. Reducing, cementing, and melting iron and other ores, &c., W. Brookes—10d.
900. Manufacture of sulphate of Alumina, A. A. Croll—4d.
901. Winding yarns or threads, A. Turner—1s. 4d.
902. Cartridge and other boxes, A. V. Newton—4d.
903. Fastenings for metallic safes, W. Milner and D. R. Ratcliff—4d.
904. Safes, T. Cook—10d.
905. Air or gas engines, J. Pinchbeck—4d.
906. Steam boilers, J. Swarbrick, D. Swarbrick, B. Swarbrick, and O. Swarbrick—10d.
907. Looms, L. Bridge—10d.
908. Loose socks or soles for boots and shoes, J. Poole and T. Brown—4d.
909. Collecting floating particles of flint, &c., E. Lake—4d.

*** Specifications will be forwarded from the Commissioners of Patents' Office, Southampton-buildings, Chancery-lane, by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office. We cannot undertake to forward Specifications, or Books advertised from the office of The English Mechanic.

PROPERTY RECORD.

SALES AT THE MASONS' HALL TAVERN.

By Messrs. Bromley, Son, and Kelday.

Freehold four residences, known as "Oakley Villas," Prince's-road, Buckhurst-hill, and a piece of land in the rear, of about half an acre, producing £84 per annum—sold for £1,160.

Freehold house, being No. 8, Gun-lane, Limehouse, let at £18 per annum—£175.

AT GARRAWAY'S. By Mr. W. Gray.

Leasehold 17 houses and shops, being Nos. 3 to 8 Charlott-place, and Nos. 1 to 9 and 36 and 39, Buxton-street, Mile-end New Town, producing £159 per annum, term 99 years from 1843 at £226 per annum—£1,150.

Leasehold property, comprising the new Market House and a part of the old Market House, Newport-market, Soho, with vaults and cellerage, and the tolls of the market, producing £407 per annum, term 27 years unexpired, at £209 per annum—£1,700.

ART NOTES.

A curious example of mismanagement has lately presented itself in the Royal Gallery at Westminster. Sir C. Barry designed with a great deal of care the niches which were destined to receive the statues intended to decorate that apartment, and, of course, considered the proportion they bore to the room. By some astonishing oversight the statues for the niches in qustion have been commissioned and partly executed by the sculptors on such a scale as precludes their admission to the niches prepared for them. The result of this blunder is that one of the best considered parts of the architect's work is being destroyed by hacking from the wall, and others must follow. The warning which presents itself to the eyes of all men of taste in St. Stephen's Hall, where the colossal statues not only dwarf the human passers-by in the most ludicrous manner, but injure the proportions and effect of a handsome chamber, has been, it seems, thrown away.

Mr. Woolner has been invited by the Department of Science and Art to execute a bust of the late Capt. Fowke, to be placed in the South Kensington Museum.—Mr. Woolner will contribute a bust of Mr. Carlyle, which has been recently finished, to the next Exhibition of the Royal Scottish Academy, Edinburgh.

Mr. Eyre Crowe has recently finished a picture representing the betrothal of Burns to Highland Mary. The parties are represented as the event actually occurred, standing one on either side of a running stream, their hands joined above its course. The background of the picture was painted on the spot where the ceremony took place, and has thus an interest beyond that which pertains to it as a work of art.

The fine collection of casts styled the Architectual Museum, which have been for some years housed at South Kensington, are about to be removed. The Committee entrusted with the management of this business wish to place them as near to Charing Cross as possible, for the convenience of art workmen and students.

USEFUL HINTS.

Restoring Ivory.—Ivory may be restored to its original whiteness by cleaning it with a paste, composed simply of burnt pumice-stone and water. After cleansing, place the article under a glass in the sun's rays.

The opium of the carnation poppy contains from 14 per cent. to 23 per cent. of morphia; that of the purple poppy, from 10 per cent. to 12 per cent., whilst the white poppy affords an amount of morphia which varies from 3·27 to 7 per cent., and rarely reaches 8 per cent.

Adulteration of Essential Oils.—An ingenious method of detecting the adulteration of essential oils with turpentine has been described by Mr. Sugden Evans. In the apparatus he employs, he avails himself of the power most essential oils possess of rotating the plane of polarization of a beam of polarized light transmitted through them either to the right hand or to the left. This instrument is simply a modified polariscope, the eye-piece of which is set in a circular disc of brass, the circumference of which is divided into 360 degrees. The prisms are so constructed that an index needle on the eye-piece points to zero when a ray of light transmitted through the apparatus is at its maximum intensity. When the light is sent through a pure oil, the ray of greatest intensity is indicated by the number to which the index needle points; and hence an impure specimen may be detected by comparing its number with that of the pure oil.

MEETINGS FOR THE WEEK.

Tuesday.—Civil Engineers, 8. Discussion upon "The hydraulic lift graving dock," and, time permitting, Mr. R. Price Williams, "On the maintenance and renewal of Permanent Way." Royal Inst., 3. Professor Frankland, "On the non-metallic elements."

Wednesday.—Society of Arts, 8. Prof. Leone Levi, "On Deer Forests and Highland Agriculture in relation to the supply of Meat." Meteorological, 7. London Institution, 7.

Thursday.—Royal, 8½. Philosophical Club, 6. Royal Inst., 3. Professor Frankland, "On the non-metallic elements." Inst. of Naval Architects, 12. Evening meeting, 7.

Friday.—Royal Inst., 3. Dr. Bence Jones, F.R.S., "On the Existence in the Textures of Animals of a fluorescent substance closely resembling Quinine." Inst. of Naval Architects, 12. Evening meeting, 7.

Saturday.—Royal Botanic, 3½. Royal Inst., 3. Rev. G. Henslow, M.A., "On Structural and Systematic Botany." Inst. of Naval Architects, 12.

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CHEMICAL NOTES.

HOW TO DETECT THE ADULTERATION OF ARROWROOT.—To those who are familiar with microscopic research, there is no very great difficulty in discovering whether the granules of arrowroot are mixed with those of the starch of potato; but to those who are not microscopists the detection of the adulteration is not easy. The method suggested by M. Albers is, therefore, useful. To one part of the arrowroot he adds three parts of a test-liquid, which consists of two parts of hydro-chloric acid of 1·120 density and one part of water. The mixture is now shaken at the ordinary temperature for about three minutes. If the arrowroot be pure it will undergo no alteration, but if it contain potato-starch this will be converted into a gelatinous substance.

PREPARATION OF CARBOLIC ACID, BY M. MULLER.—Phenic acid or phenylic alcohol is usually accompanied by its congeners, xylic and cresylic alcohols, which adhere to it with great tenacity, and give it the property of becoming brown in contact with the air. For its purification the author has recourse to a partial neutralisation, and afterwards to the fractional distillation of the product. The crude tar cedes to soda or lime water a mixture of the matters before mentioned, as well as naphthaline, which is soluble in concentrated solutions of the alkaline phenates. Water is added to this until it ceases to cause a precipitate, when the liquid is exposed in wide vessels, to facilitate the formation of the brown bodies and their deposit. After filtering, the approximative quantity of organic matter held in solution is determined; formed principally of phenic acid and its congeners, which are easily displaced by acids. The phenic acid is always the last to separate, so that it is easy to disembarrass it of its associated matter and brown oxidised product by adding carefully the proportion of acid determined by calculation, so as to precipitate at first only these matters, and by means of several trials it is easy to arrive at the proper point to stop, so as to retain the phenate nearly pure. The acid is now separated and rectified, and soon crystallises. As a little water prevents its crystallisation, the author removes it by passing a current of dry air over the phenic acid nearly boiling. The crystallisation is facilitated by cooling, or by the introduction into it of a small quantity of the crystallised acid. The author insists on the necessity of exposing the alkaline solution of the acid for a long time to favour the resinification and deposition of the brown matters; phenic acid is always impure when it is coloured. It should be quite pure when employed to make picric acid, because the impurities waste the nitric acid. Phenic acid often contains a fetid substance, which appears to be a sulphuretted compound of phenyl or cresyle. It is removed by rectification from oxide of lead.—*From Zeitsch. fur Chem., in Journ. de Pharm.*, Nov., 1865.

BUILDING AND ENGINEERING CONTRACTS OPEN FOR TENDER.

Tenders are required for dredging, for the War Department, at the Royal Arsenal, Woolwich. Particulars at the Works Department, Royal Arsenal.

Supply of Gas Breeze for Aylesford and Burham Brick Company. Particulars of Mr. Slater, Cannon Wharf, Thames Embankment, Westminster.

Erection of a New Treadwheel and the alteration of the Female wing of Huntingdon Gaol. Particulars of Messrs. Pownall and Young, No. 30, Gower-street, London.

Erection of a Villa Residence, at Monkey Island, near Maidenhead, Berkshire. Particulars of R. A. Potts, Esq., 4, Queen-square, Westminster.

Erection of a New School and Residence, at Steeple Morden, near Royston, Cambridgeshire. Particulars of Messrs. Elmslie Franey and Haddon, 43, Parliament-street, Westminster.

Carpenters and Builders are required to estimate for alterations and repairs at 12, Bell-yard, Temple Bar, where particulars can be obtained.

Taking down and rebuilding, No. 1, Falcon-square, City. Particulars of Mr. J. H. Machin, No. 13, Twisters alley, Bunhill-row.

Erection of a Public-house in Wigram's-lane, Wanstead. Particulars at the office of the Architect, 10, Florence-street, Upper-street, Islington.

TENDERS SENT IN FOR BUILDING WORKS.

For temporary church, Sunbury. Mr. W. Wigginton, architect:—Axford & Whillier, £960; Wheatley, £632; Hearle, £595.

For Christ Church, Gipsy-hill, Norwood. Mr. J. Giles, architect. Quantities supplied by Mr. D. Young:—McLachland, £9,425; Carter & Son, £9,015; Mars and, 8,150; Sawyer, 7,703; Sims & Marten, 7,418; Aviss and Son, 7,313; Jones, 7,070; Dover, 6,397; Bysh, 7,299

For the erection of new wing to St. Mary's Hospital, Paddington. Mr. W. Wigginton, architect:—Nutt & Co. (accepted), £5,866.

For twelve cottages at Basted, in the Parish of Wrotham, Kent. Messrs. Morphew & Aldridge, architects:—Fitness, £2,700; Stevens, £1,950; Hoadley, £1,949, Yates, £1,900.

For villa residence, Sevenoaks, New Park, for Dr. Lovegrove. Messrs. Morphew & Aldridge, architects:—Grover, £2,639; Yates, £2,568; Hoadley, £2,490; Stevens, 2,250.

For alterations and additions to the Woodlands, Southwood-lane, Muswell-hill. Mr. F. G. Widdows, architect:—Colls & Son (accepted) £3,442.

For a market house, town hall, and public rooms, &c., at Camborne, Cornwall, exclusive of granite dressings paving, and fittings, for butchers' market and town hall Mr. W. Bond, jun., architect:—Vivian & Bennett (accepted) £3,550.

For a new warehouse, Gun-street, Spitalfields. M Robert P. Notley, architect:—Wills (accepted), £1,423.

PRICES CURRENT OF TIMBER.

Per load—	£ s.	£ s.	Per load—	£ s.	£ s.
Teak	11 10	12 10	Canada, indqual.	12 10	14 10
Quebec, red pn.	3 5	4 15	St. Petersburg yel.	10 10	12 0
yellow pine	2 15	3 10	Finland	8 0	10 0
Memel	0 0	0 0	Memel	0 0	0 0
elm	3 10	5 0	Christiania, per C. 12 ft. by 3 by 9 in. yellow	18 0	23 0
Dantzic oak	3 0	6 0	Deck, Plank, Dantzic, per 40 ft. 5 in.	0 14	1 6
fir	2 5	3 10	Staves, per standard M.		
Memel fir	3 0	3 10	Quebec, pipe	80 0	85 0
Riga	3 5	3 10	puncheon	20 0	25 0
Swedish	2 0	2 10	Baltic crown pipe	170 0	190 0
Masts, Quebec, rd. pine	6 10	8 10			
yellow pine	5 0	6 0			
red pine	0 0	0 0			
Lathwood, Dantzic	5 10	6 10			
St. Peter's	7 0	8 0			
Yellow Pine, per reduced C.					
Canada, 1st qual.	17 10	20 0			

MISCELLANEOUS.

	£ s.	£ s.		£ s.	£ s.
PUMICE STONE pr ton	5 0	8 0	Olive, Gallipoli	56 0	56 10
OILS, &c.			Cocoanut, Coch. ton	52 0	53 0
Seal, pale pr. tun	50 0	0 0	Palm, fine	42 10	0 0
Sperm body	120 0	122 0	Linseed	40 5	40 10
Cod	50 0	0 0	Rapeseed, Eng. pale	50 0	0 0
Whale, Sth Sea pale	48 0	50 0	Cotton, seed	32 10	39 0

LATEST PRICES OF METALS.

		£ s. d.	£ s. d.
COPPER.			
British—cake and tile	per ton	94 0 0	96 0 0
Sheet	do	96 0 0	101 0 0
IRON.			
Pig in Scotland	per ton.	3 17 0 cash.	
Welsh Bars, in London	do	7 15 0	8 0 0
Wales	do	6 15 0	7 0 0
Staffordshire	do	8 15 0	0 0 0
Sheets, single in London	do	10 15 0	0 0 0
Hoops, first quality	do	9 15 0	—
LEAD.			
Pig, Foreign	per ton	20 0 0	20 5 0
Red or minium	do	22 0 0	—
QUICKSILVER	per bottle	7 15 0	8 0 0
STEEL.			
Swedish faggot	per ton	0 0 0	—
,, Kegs	do	15 5 0	15 10 0
TIN.			
English Blocks	per cwt	4 10 0	4 11 0
Banca	do	4 7 0	—

LONDON COAL EXCHANGE.

PRICES OF COALS PER TON.

Cowpen Hartley, 15s. 9d.; Ellison Steam, 15s.; Holywell Main, 15s. 6d.; Wylam, 15s. 6d.; Brancepeth Channel, 17s. 6d.; Cym Garnant Stone, 22s. 6d.; Shaw's Hartley, 18s. 6d.; North Staffordshire, 17s.—Walls End Gosforth, 15s. 6d.; Walls End Harton, 15s. 6d.; Walls End Wharncliffe, 16s.; Walls End Framwellgate, 15s. 6d.; Walls End Haswell, 19s.; Walls End Hetton, 19s.; Walls End Hetton Lyons, 15s. 6d.; Walls End South Hetton, 18s. 6d.; Walls End Tunstall, 15s. 6d.; Walls End Caradoc, 18s.; Walls End Hartlepool, 18s. 9d.; Walls End Kelloe, 16s. 3d.; Walls End Thornley, 16s 6d. Ships at market, 79; sold, 62; unsold, 17; at sea, 40.

IMPORTANT TO ADVERTISERS.

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ALL PERSONS are hereby cautioned against manufacturing, purchasing, or selling any Differential Pulley Blocks similar to Weston's Patent not manufactured by the Plaintiffs. Application will forthwith be made to the Court of Chancery for INJUNCTIONS against all persons who may be found infringing Weston's Patent after this Notice. The Blocks may be obtained from the Plaintiffs' Wholesale Agents, S. and E. Ransome & Co., 31, Essex-street, Strand, London, W.C.

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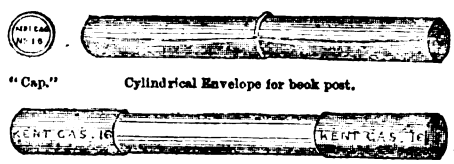

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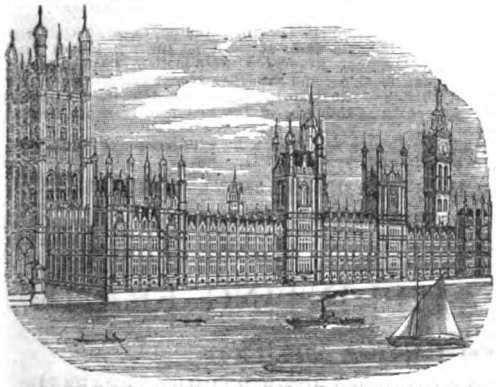

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